

DEPARTMENT OF COMMERCE

Chapter Comm 23**HEATING, VENTILATING AND AIR CONDITIONING STANDARDS**

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Note: Chapter Ind 23 was renumbered to be chapter ILHR 23, Register, February, 1985, No. 350, eff. 3-1-85. Chapter ILHR 23 was renumbered Chapter Comm 23 under s. 13.93 (2m) (b) 1., Stats., and corrections made under s. 13.93 (2m) (b) 7., Stats., Register, January, 1999, No. 517.

Subchapter I — Scope**Comm 23.01 Scope.**

The provisions of this chapter shall apply to the design, installation and construction of all heating, ventilating and air conditioning systems in dwellings covered by this code.

Subchapter II — Design**Comm 23.02 Design.**

Every dwelling shall be equipped with a heating system designed in accordance with this section. Heating equipment requirements may be waived for recreational dwellings used only during the non-heating season. Where a cooling system is provided, the cooling requirements of this section shall be met.

Recreational or Small Dwellings

Question: Does a house need a heating system?

Answer: *No. It would then be considered a recreational or seasonal dwelling as defined in s. Comm 20.04(1). Compliance with Ch. 22, Energy Conservation, would not be required if there is no heating system. However, an owner would be required to retrofit the house to meet Ch. 22 standards before it could be heated and used for year-round use in the future. Some foresight by the builder/owner would be necessary if they contemplate it may be used year-round in the future*

(1) HEATING AND COOLING SYSTEM DESIGN. (a) Indoor and outdoor design temperatures shall be selected from s. Comm 22.07.

(b) The heating and cooling systems shall be designed to maintain the indoor design temperature at outdoor design conditions.

(c) When requested, room-by-room heat loss and heat gain calculations shall be furnished.

(2) DISTRIBUTION SYSTEMS. Distribution systems shall be sized and located to satisfy the heating and cooling loads of each conditioned space. When requested, a layout of the distribution system shall be furnished to show that the system meets the requirements of this code.

(3) VENTILATION. (a) General. All exhaust vents shall terminate outside the structure.

1. Mechanical ventilation systems shall be balanced.

Question: *What does "balanced" mean in this section?*

Answer: *It means that the ventilation system should not produce excessive positive or negative pressures in the dwelling.*

2. Infiltration may not be considered as make-up air for balancing purposes.

3. All exhaust vents shall terminate outside the structure.

Exhaust Fan Termination

Question: *Can an exhaust fan terminate inside a garage, crawlspace or attic near a vent?*

Answer: *No. It must have an exterior termination. The air currents may otherwise draw the exhaust back into the space.*

4. Intake air ducts shall be sized to provide a maximum of 40% of the total air that would be exhausted with all exhaust ventilation in the dwelling acting simultaneously.

Question: *What calculation method can be used to determine the make-up air needed for exhaust fans?*

Answer: The minimum amount of make-up air must be 40% of the total exhaust. Size the duct considering the maximum flowrate conditions specified in s. Comm 23.07. Comm 23.07 - TABLE (DUCT VELOCITIES) Per this table, the minimum duct velocity is 500 ft/min and maximum allowable is 800 ft/min.

Example: Determine size of make-up air duct required for these exhaust systems.

Range hood	=	180 cfm (intermittent)	x	40%	=	72 cfm
Bath exhaust 1	=	50 cfm (intermittent)	x	40%	=	20 cfm
Bath exhaust 2	=	75 cfm (intermittent)	x	40%	=	30 cfm
TOTAL		305 cfm (intermittent)	x	40%	=	122 cfm

Based on the formula of Quantity = Velocity times Area ($Q=VA$). THEREFORE:...

$A=Q/V$, or $A=122/800$, or $A=.1525$ sq. ft. x 144 = 21.96 sq. in. (Required)

Try 4" Round duct = $3.14 \times \text{radius squared} = 3.14 \times 2 \times 2 = 12.56$ sq. in. (Too small)

Try 6" Round duct = $3.14 \times \text{radius squared} = 3.14 \times 3 \times 3 = 28.26$ sq. in. (OK, since >21.96)

Not doing the calculation described above to appropriately size the air intake may result in an oversize intake and cause the problems noted above. Note: System should be tested per 23.18 to make sure the design amounts of air are actually provided when the system operates.

5. Kitchen range hoods that exhaust air from the kitchen area shall terminate outside the structure and shall be considered as exhaust ventilation for balancing and makeup purposes.

6. Kitchen range hoods that are listed and installed to recirculate air without exhausting it are not required to be balanced.

(b) 1. 'General.' Except as provided under subd. 2., mechanical ventilation systems shall be balanced.

2. 'Exception.' Passive intake air ducts providing makeup air for intermittent exhaust fans shall be sized to provide at least 40 percent of the total air that would be exhausted with all intermittent exhaust ventilation in the dwelling operating simultaneously.

3. 'Kitchen range hoods.' a. Kitchen range hoods that exhaust air from the kitchen area are considered as exhaust ventilation for balancing and makeup purposes.

b. Kitchen range hoods that are listed and installed to recirculate air without exhausting it are not required to be balanced.

4. 'Infiltration.' a. Infiltration may be considered as makeup air for balancing purposes only where there are no naturally vented space- or water-heating appliances in the dwelling.

b. For the purpose of complying with this subdivision, naturally vented space- or water-heating appliances are those that take combustion of dilution air from inside the dwelling, including unsealed fireplaces and draft hood appliances with power venting.

Note: Whole-house fans that are used in the summer to bring cool night air in through open windows and exhaust into the attic are considered to be a supplemental cooling system rather than part of the ventilation system.

Note: See s. Comm 22.14 for additional requirements on mechanical ventilation.

(c) Habitable rooms. Habitable rooms without openable windows shall be provided with a balanced mechanical ventilation system producing one air change per hour of fresh outside air while the room is occupied.

(d) Rooms with toilets, tubs or showers. Any room with a toilet, tub or shower shall be provided with exhaust ventilation capable of exhausting 50 cubic feet per minute on an intermittent basis or 20 cubic feet per minute on a continuous basis.

Note: The department will accept designs which meet the Air Conditioning Contractors of America manual; the Mechanical Contractors Association manual; and the Sheet Metal and Air Conditioning Contractors National Association standards for heating and air conditioning systems for one- and 2-family dwellings.

Ductless Recirculating Fans

Question: *Are there any department-approved ductless recirculating bathroom fans that may be used in lieu of natural ventilation or mechanical ventilation?*

Answer: *No. In rooms with a toilet, tub, or shower, it is required by (3)(d) that mechanical exhaust fans, ducted to outside the dwelling, be installed even where openable windows are present.*

(4) CONTROLS. The temperature rise through the equipment shall not exceed 100° F unless listed. Controls shall be provided to maintain the inside temperature. Where forced, warm-air systems are used, controls shall be installed to control air movement.

Subchapter III — Heating Equipment

Comm 23.03 Selection of equipment.

All heating and central cooling equipment shall be selected on the basis of air-handling capacity, pumping capacity, and thermal capacity to handle the calculated design heating or cooling load.

Selection of Equipment

Question: *The UDC Energy Worksheet or Wischeck is used to determine both the maximum and minimum heating system output. Can this minimum be reduced?*
Answer: *Yes, if proper calculations are submitted showing any solar gain, internal gain from appliances or other sources.*

Comm 23.04 Types and location of equipment.

All heat producing appliances and cooling appliances shall be listed by a testing agency acceptable to the department. The clearances from combustible materials in Tables 23.04-A and 23.04-B shall apply unless otherwise shown on listed appliances.

Types of Equipment

All heating equipment including woodstoves and decorative gas appliances (gas fireplaces) must be listed by a recognized testing agency. An important part of inspecting an appliance's installation is to check against its listed installation requirements. Therefore, it is good practice to refer to the installation manual when installing and inspecting the installation. Per s. Comm 23.18(1), an appliance's manual is required to be left with the owner. Per s. Comm 20.09, it can be required for plan review or inspection by the inspector.

Table 23.04-A
STANDARD INSTALLATION CLEARANCES (INCHES) FOR HEAT-PRODUCING APPLIANCES

Residential Type Appliances for Installation in Rooms Which are Large See Note 2		Appliances ¹				
		Above Top of Casing or Appliance	From Top and Sides of Warm- Air Bonnet or Plenum	From Front See Note 3	From Back	From Sides
Boilers and Water Heaters						
Automatic Oil						
Steam Boilers - 15 psi	or	6	---	24	6	6
Water Boilers - 250°F	Comb. Gas-Oil					
Water Heaters - 200°F	Automatic Gas	6	18	6	6	
All Water Walls or Jacketed	Electric	6	---	18	6	6
Furnaces - Central						
Gravity, Upflow, Downflow, Horizontal and Duct, Warm-Air - 250°F	Automatic Oil	6 ⁴	6 ⁴	24	6	6
	or					
	Comb. Gas-Oil	6 ⁴	6 ⁴	18	6	6
	Automatic Gas	6 ⁴	6 ⁴	18	6	6
	Electric	6 ⁴	6 ⁴	18	6	6
Furnaces - Floor						
For Mounting in Combustible Floors	Automatic Oil	36	---	12	12	12
	or					
	Comb. Gas-Oil	36	---	12	12	12
	Automatic Gas	36	---	12	12	12
	Electric	36	---	12	12	12
Heat Exchanger						
Steam - 15 psi Max.						
Hot Water - 250°F Max.	---	1	1	1	1	1
Room Heaters						
Circulating Type	Oil	36	---	24	12	12
Vented or Unvented	Gas	36	---	24	12	12
	Oil	36	---	36	36	36
Radiant or Other Type	Gas	36	---	36	18	18
Vented or Unvented	Gas with dbl Metal or Ceramic back	36	---	36	12	18
Radiators						
Steam or Hot Water	Gas	36	---	6	6	6

Table 23.04-A (Continued)

Residential Type Appliances for Installation in Rooms Which are Large See Note 2		Appliances ¹					
		Above Top of Casing or Appliance See Note 5	From Top and Sides of Warm- Air Bonnet or Plenum	From Front See Note 3	From Back	From Sides	
						Firing Side	Opp. Side
Ranges - Cooking Stoves Vented or Unvented	Oil	30	---	---	9	24	18
	Gas	30	---	---	6	6	6
	Electric	30	---	---	6		6
Clothes Dryers Listed Types	Gas	6	---	24	6		6
	Electric	6	---	24	0		0
Incinerators		See Note 6					
Residential Types	---	36	---	48	36		36

¹ Standard clearances may be reduced by affording protection to combustible material in accordance with Table 23.04-B.

² Rooms which are large in comparison to the size of the appliance are those having a volume equal to at least 12 times the total volume of a furnace and at least 16 times the total volume of a boiler. If the actual ceiling height of a room is greater than 8 feet, the volume of a room should be figures on the basis of a ceiling height of 8 feet.

³ The minimum dimension should be that necessary for servicing the appliance including access for cleaning and normal care, tube removal, etc.

⁴ For a listed oil, combination gas-oil, gas, or electric furnace, this dimension may be 2 inches if the furnace limit control cannot be set higher than 250°F or this dimension may be one inch if the limit control cannot be set higher than 200°F.

⁵ To combustible material or metal cabinets. If the underside of such combustible material or metal cabinet is protected with asbestos millboard at least 1/4 inch thick covered with sheet metal of not less than No. 28 gauge, the distance may be not less than 24 inches.

⁶ Clearance above charging door should be not less than 48 inches.

Table 23.04-B
CLEARANCES, INCHES, WITH SPECIFIED FORMS OF PROTECTION*

Type of Protection Applied to the combustible material unless otherwise specified and covering all surfaces within the distance specified as the required clearance with no protection. Thicknesses are minimum.	Where required clearances with no protection is:											
	36 Inches			18 Inches			12 Inches			6 Inches		
	Above	Sides and Rear	Vent Con- nector	Above	Sides and Rear	Vent Con- nector	Above	Sides and Rear	Vent Con- nector	Above	Sides and Rear	Vent Con- nector
(a) 1/4" insulating millboard** spaced out 1"***	30	18	20	15	9	12	9	6	6	3	2	3
(b) 28 gauge sheet metal on 1/4" insulation millboard**	24	18	24	12	9	12	9	6	4	3	2	2
(c) 28 gauge sheet metal spaced out 1"***	18	12	18	9	6	9	6	4	4	2	2	2
(d) 28 gauge sheet metal on 1/4" insulation millboard** spaced out 1"***	18	12	18	9	6	9	6	4	4	2	2	2
(e) 1/4" insulated millboard** on 1" mineral wool batts reinforced with wire mesh or equivalent.	18	12	18	6	6	6	4	4	4	2	2	2
(f) 22 gauge sheet metal on 1" mineral wool batts reinforced with wire or equivalent.	18	12	12	4	3	3	2	2	2	2	2	2
(g) 1/4" insulated millboard***	36	36	36	18	18	18	12	12	9	4	4	4

* All clearances shall be measured from the outer surface of the equipment to the combustible material disregarding any intervening protection applied to the combustible material.

** A factory fabricated board formed with noncombustible materials, normally fibers, and having a thermal conductivity in the range of 1 Btu inch per square foot per °F, or less.

*** Spaces shall be of noncombustible material.

(1) FURNACES. The input and output capacity of furnaces shall be listed on the nameplate. All nameplates shall show evidence that the equipment has been listed by a recognized testing laboratory.

(a) Fuel supply. Furnaces shall be fired with the fuel for which they have been approved, except as provided in par. (d). Fuels shall be supplied to the furnace in the volume and at the pressure required on the label.

(b) Unvented furnaces and space heaters. The use of unvented furnaces and space heaters fueled by natural gas, kerosene, alcohol or other fuel shall be prohibited due to concerns about oxygen depletion; contamination from carbon monoxide, carbon dioxide, nitrogen dioxide, formaldehyde and other combustion related contaminants; and water vapor buildups.

(c) Vented wall furnaces. Vented wall furnaces shall not be equipped with duct extensions beyond the vertical and horizontal limits of the enclosure unless listed. Vented wall furnaces shall be located to prevent the restriction of air circulation by doors, projections, or other openings. Vented wall furnaces shall be provided with combustion air.

Unvented Furnaces and Space Heaters and Fireplaces

Portable kerosene and other types of unvented heaters are being advertised and sold in Wisconsin. However, neither the Commercial Building Code nor the Uniform Dwelling Code permit their use. Use of such heaters is prohibited because the heaters are not vented and can cause a buildup of carbon monoxide and moisture in the room. Further, the heaters require frequent refueling which can lead to spillage and additional fire hazard.

A carbon monoxide problem can develop where improper fuels are used or inadequate ventilation is provided. To comply with the terms of their listings, most units being advertised must utilize the type "I-K" odorless kerosene to enable them to burn at low carbon monoxide levels. Unfortunately, this type of kerosene is available in Wisconsin only on a very limited basis, usually to commercial customers. Use of other kerosene makes the listing meaningless. In homes not covered by the Uniform Dwelling Code, homeowners should be made aware that, where heaters are used, special care should be taken to ensure the proper fuels and ventilation are provided.

Question: *If unvented heaters are prohibited by the UDC and the Commercial Building Code, why are kerosene heaters still being sold?*

Answer: *These heaters are not necessarily illegal in structures not covered by either code, such as pre-1980 dwellings or agricultural buildings. However, some municipalities have adopted ordinances prohibiting unvented heaters in pre-1980 dwellings or other buildings.*

Question: *Can an unvented heater be used in a residential garage?*
Answer: *Only in detached garages since the UDC Comm 20.07 (35) defines an attached garage as part of the dwelling. Therefore, the garage would have to comply with all chapters of the UDC. Most municipalities have their own ordinances of codes covering construction of accessory buildings.*

(d) Conversion burners. Conversion burners shall be listed by a recognized testing laboratory. The existing equipment shall be reconditioned and defective parts replaced before a conversion burner is installed. Conversion burners shall be installed in accordance with the installation instructions.

(2) HEAT PUMP APPLIANCES. (a) Size. Heat pump appliances shall be sized to provide control of the wet and dry bulb temperatures during cooling and maximum performance during heating. The heating balance point shall be considered to determine the outdoor temperature at which the heat pump must operate 100% of the time to offset the dwelling heat loss.

(b) Auxiliary heaters. Provisions for auxiliary heat to supplement the heat pump at outdoor temperatures below the balance point shall be provided. Auxiliary heaters shall be sized so that the heat pump auxiliary will offset the dwelling heat loss down to the heating design temperature.

(3) BOILERS. Boilers shall comply with ch. COMM 41-42, Boiler and Pressure Vessel Code, ss. COMM 41.10 and 41.42 through 41.45.

Note: The department will accept equipment listed by the American Society of Mechanical Engineers, Underwriters' Laboratories, and the American Gas Association.

See informational flyer at the back of this chapter regarding water heaters used for space heating purposes.

(4) LOCATION. (a) Enclosed spaces. Except as provided in par. (c), no space-heating or water-heating appliance shall be installed in a bedroom, bathroom, closet, or garage unless listed for such installation.

(b) Garages. Appliances installed in garages shall have burners and burner ignition devices located at least 18 inches above the floor and shall be protected or located so the furnace is not subject to damage from a vehicle.

(c) Exceptions. 1. Vented decorative gas appliances and decorative gas appliances for installation in vented fireplaces may be installed in bedrooms or bathrooms only when both of the following conditions are met:

a. The volume of the space in which the appliance is located is not less than 50 cubic feet per 1000 Btu/h of the combined input rating of all fuel-burning appliances installed in that space.

The space may be made up of more than one room if the rooms are connected through doorway openings without doors.

b. The vapor retarder is not continuous on walls and ceilings exposed to the outside atmosphere as allowed under s. Comm 22.22.

2. Water heaters may be installed in a closet located in a bathroom or bedroom where the closet is used exclusively for the water heater, where the enclosed space has a weather-stripped solid door with a self-closing device, and where all air for combustion is obtained from the outdoors.

Note: Section Comm 23.06 still requires combustion air to be provided to the appliance.

Location

Question: *How do I determine if a furnace is listed for installation in a bedroom, bathroom, closet or garage?*

Answer: *Although this information may not be shown on the unit, it does need to be covered in the installation instructions which must be provided to the owner, per s. Comm 23.18. Many times these installation instructions reference NFPA-54, National Fuel Gas Code for garage installation procedures.*

Question: *Since this section limits location of furnaces in a garage, can a wood stove or other space heater be located in a garage?*

Answer: *Not unless listed for such use. See s. Comm 23.045(2)(c).*

Question: *Can a furnace be located in an attic?*

Answer: *Yes, if within the manufacturer's listing requirements. The following UDC requirements and typical manufacturer's requirements would usually apply:*

- *Provide attic access opening large enough for the appliance.*
- *Provide combustion air per s. Comm 23.06.*
- *Maintain manufacturer's and UDC clearances to combustibles and clearances for servicing.*
- *Provide lighting for servicing the appliance.*
- *Provide a solid walkway to the appliance and solid platform under and around the appliance for servicing.*
- *The attic framing must be designed to support the furnace and servicing loads.*
- *Isolate the appliance from any loose insulation that could enter the combustion chamber.*
- *Isolate the appliance from any drafts caused by power attic venting of the attic.*

Also, the furnace must be able to withstand freezing temperatures which may adversely affect condensing-type furnaces.

Comm 23.045 Solid-fuel-burning appliances.

(1) GENERAL. Solid-fuel- burning appliances shall be installed as specified in this section unless the manufacturer or listing specifies the use of protection or clearances other than those specified in this section. All solid-fuel-burning appliances shall be tested and listed by an accepted testing agency.

Note: Factory-built fireplaces shall comply with s. Comm 21.32.

Solid-Fuel-Burning Appliances

Effective February 1, 1989, solid-fuel-burning appliances had to be tested, listed and labeled by an accepted testing agency. (See s. Comm 21.32 commentary for approved agencies.)

At the time the Dwelling Code was first written (1980), nationally recognized standards on solid-fuel-type appliances were not available. Since that time, Underwriters' Laboratories have developed standards for testing and listing solid-fuel- burning appliances. Most models on the market are now tested, listed and labeled by approved independent agencies.

Appliance Testing and Listing

When a specific installation instruction approved by the testing/listing agency is more or less stringent than s. Comm 23.045, then the listing agencies instructions govern.

(2) LOCATION OF APPLIANCES. (a) Servicing. Every appliance shall be located to permit access to the appliance. Sufficient clearance shall be maintained around the equipment to permit cleaning of surfaces; the replacement of air filters, blowers, motors, controls and chimney connectors; the lubrication and servicing of moving parts; and the adjustment and servicing of stokers and appliance components.

(b) Garages. Solid-fuel-burning appliances may not be installed in a garage.

(3) CHIMNEYS. (a) Solid-fuel-burning appliances shall be connected to one of the following types of chimneys:

1. Factory-built chimneys or vents. A listed residential-type and building heating appliance chimney may be used with solid-fuel-burning appliances if the chimneys have been tested 3 times to a minimum flue gas temperature exposure of 2100° F, under the conditions specified by the listing agency, for at least 10 minutes each time.

Note: Products listed and labeled as complying with UL 103 – "Type HT" meet this requirement. UL 103 uses several temperature ranges for different products but only the "Type HT"-designated products have met the 2100°F testing requirement.

2. Masonry chimneys. Masonry chimneys shall be constructed as specified in s. Comm 21.30.

(b) Wood-burning equipment shall not be connected to a flue serving a fireplace or other equipment.

Co-venting of Solid-Fuel Appliances

Note that this section does not allow co-venting of solid-fuel appliances. Each fireplace, woodstove, or other solid-fuel appliance must be vented to its own flue.

(c) The chimney shall be designed to create a natural draft to carry away the products of combustion or provision shall be made for mechanically maintaining constant updraft during equipment operation.

(d) A cleanout opening shall be provided.

(e) A listed, multifuel appliance may be vented into a single flue.

(4) CHIMNEY CONNECTORS. (a) All solid-fuel-burning appliances shall be connected to chimneys with factory-built chimney material, Type L vent material or steel pipe with minimum thicknesses as specified in Table 23.045-A.

TABLE 23.045-A

METAL THICKNESS FOR PIPE CONNECTORS

Diameter of Connector (inches)	Sheet Gage No.	Minimum Thickness (inches)
6 to 10	24	.023
over 10 to 16	22	.029
over 16	16	.056

(b) The required clearance to combustibles for chimney connectors shall be 18 inches. This clearance may be reduced in accordance with Table 23.045-B. The specified protection shall be applied to and cover all combustible material as specified in Figure 23.045-A.

(c) Connectors and chimneys for solid-fuel-burning appliances shall be designed, located and installed to permit ready access for internal inspection and cleaning.

(d) 1. Chimney connectors shall have no more than two 90° elbows.

2. The horizontal length shall not exceed 75% of the total vertical height of the entire venting system measured from the appliance outlet.

3. The connector shall maintain a rise of at least 1/4 inch per foot from the appliance outlet to the chimney inlet.

4. Connectors shall be securely supported and joints fastened with a minimum of 3 sheet metal screws or rivets.

5. Appliances used mainly for wood burning shall have the joints assembled so that the crimped end points towards the stove. Appliances burning coal shall have the joints assembled so that the crimped end points away from the appliance.

6. A connector to a masonry chimney shall extend through the wall to the innerface of the liner but not beyond.

7. The effective area of the connector shall not be less than the area of the appliance flue collar.

(e) No chimney connectors may pass through any floor, ceiling, window, door or combustible wall nor be concealed in any closet, attic or similar space. A connector may pass through a combustible wall if the connector is guarded at the point of passage by one of the following methods:

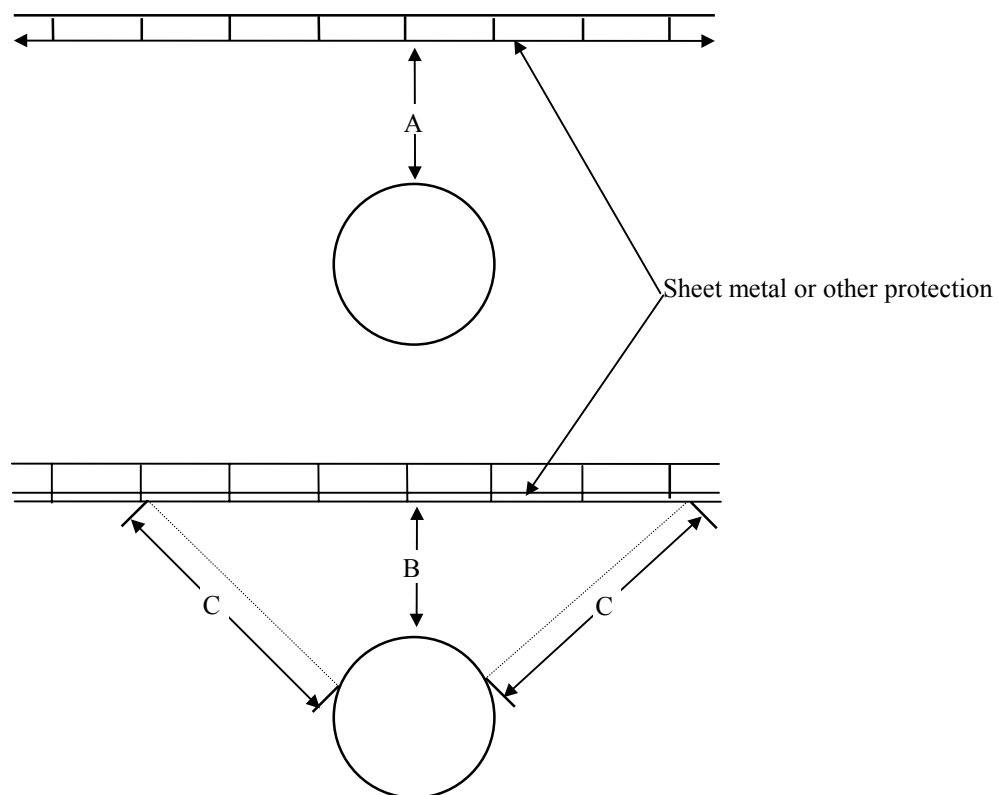
1. Metal ventilated thimble not less than 12 inches larger in diameter than the connector.

2. All combustible material in the wall is cut away from the connector a sufficient distance to provide the required 18-inch clearance. Any material used to close up such openings shall be noncombustible.

(f) A manual, cast iron damper to control draft shall be provided in the chimney connector. The damper shall not obstruct more than 80% of the connector area. Listed solid-fuel appliances whose listing prohibits the use of manual dampers in the connector shall not require a manual damper to be installed.

FIGURE 23.045-A

CONSTRUCTION USING COMBUSTIBLE MATERIAL



"A" Equals the required clearance with no protection, specified in s. Comm 23.045 (4) (b).

"B" Equals the reduced clearance permitted in accordance with Table 23.045-B. The wall protection should extend far enough in each direction to make "C" equal to "A".

TABLE 23.045-B

Type of Protection	Minimum Required Connector Clearances (inches)
0.013-in. (28 gage) sheet metal spaced out a minimum of one inch.	9
3 1/2-in. thick masonry wall spaced out a minimum of one inch and adequately tied to the wall being protected (see Note 4).	9
0.027-in. (22 gage) sheet metal on one-inch mineral wool batts reinforced with wire or equivalent spaced out a minimum of one inch.	3

¹ Spacers and ties shall be of noncombustible material.

² All methods of protection require adequate ventilation between protective material and adjacent combustible walls and ceilings.

³ Mineral wool batts (blanket or board) shall have a minimum density of 8 pounds per cubic foot and a minimum melting point of 1550° F.

⁴ If a single wall connector passes through the masonry wall, there shall be at least 1/2 inch of open ventilated air space between the connector and the masonry.

Chimney Connectors

Question: Does a solid fuel appliance in front of an existing fireplace opening require a chimney connector?

Answer: Usually, for proper operation, a smokepipe is needed from the appliance outlet to the opening of the actual chimney flue per its listing. Additionally, a factory-built fireplace's listing must be compatible for such an alteration.

(5) MOUNTING ON FLOORS. (a) Appliances shall be placed on surfaces as described in Table 23.045-C. Solid-fuel-burning appliances listed specifically for installation on a floor constructed of combustible material may be installed in accordance with the terms of the listing and the manufacturer's instructions.

TABLE 23.045-C

FLOOR MOUNTINGS FOR SOLID-FUEL-BURNING APPLIANCES

Kind of Appliance	Allowed Mounting
(1) All forced air and gravity furnaces, steam and water boilers. or	Floors of fire-resistive construction with noncombustible flooring and surface finish, or fire-resistive arches or slabs. This construction may not have combustible material against the underside. Such construction shall extend at least 18 inches beyond the appliance on all sides.
(2) Residential-type ranges, water heaters, fireplace stoves, room heaters and combination fireplace stove/room heaters, having less than 2 inches of ventilated open space beneath the fire chamber or base of the appliance.	These appliances shall not be placed on combustible floors.
(3) Residential-type ranges, water heaters, fireplace stoves, room heaters and combination fireplace stove/room heaters having legs or pedestals providing 2 to 6 inches of ventilated open space beneath the fire chamber or base of the appliance.	On combustible floors when such floors are protected by 4 inches of hollow masonry, laid to provide air circulation through the masonry layer. Such masonry shall be covered with 24 gauge sheet metal. The required floor protection shall extend at least 18 inches on all sides of the appliance.
(4) Residential-type ranges, water heaters, fireplace stoves, room heaters and combination fireplace stove/room heaters having legs or pedestals providing over 6 inches of ventilated open space beneath the fire chamber or base of the covered appliance.	Noncombustible floors shall extend at least 18 inches on all sides of the appliance. On combustible floors when such floors are protected by closely spaced masonry units of brick, concrete or stone, which provide at least 2 inches of thickness. Such masonry shall be covered by or placed over a sheet of 24 gauge sheet metal. The required floor protection shall extend at least 18 inches on all sides of the appliance. Noncombustible floors shall extend at least 18 inches on all sides of the appliance.

(6) CLEARANCES. (a) Solid-fuel-burning appliances shall be installed with clearances not less than specified in Table 23.045-D.

1. Listed appliances exception. Listed appliances shall be installed in accordance with the terms of their listing if greater clearances other than those specified by Table 23.045-D are required in accordance with the listing.

2. Clearance with protection exception. Solid-fuel-burning appliances may be installed with reduced clearances provided the combustible material is protected as described in Table 23.045-E. The specified protection shall be applied to and cover all combustible material as specified in Figure 23.045-B.

TABLE 23.045-D

STANDARD CLEARANCES FOR SOLID-FUEL-BURNING APPLIANCES

Type of Appliance	Above Top of Casing or Appliance. Above Top and Sides of Furnace Plenum or Bonnet (inches)	Minimum Standard Clearances (inches)		
		From Front	From Back	From Sides
<u>Residential Appliances</u>				
Steam Boilers - 15 psi				
Water Boilers - 250° F max.	6	48	6	6
Water Boilers - 200° F max.				
All Water Walled or Jacketed				
<u>Furnaces</u>				
Gravity and Forced Air	18	48	18	18
<u>Room Heaters, Fireplace Stoves, Combinations</u>				
	36	36	36	36
			Firing Opp. Side	Side
<u>Ranges</u>				
Lined Firechamber	30	36	24	18
Unlined Firechamber	30	36	36	18

TABLE 23.045-E

MINIMUM ALLOWABLE APPLIANCE CLEARANCE WITH PROTECTION^{1,2,3,4,5,6}

Type of Protection	Unprotected Clearances (inches) From Table 23.045-D								
	For Ceilings				For Walls				
	6	18	30	36	6	18	24	36	48
3 1/2-in. thick masonry wall without ventilated air space	-	-	-	-	4	12	16	24	32
1/2-in. thick noncombustible insulation board over 1-in. glass fiber or mineral wool batts without ventilated air space	4	12	20	24	3	9	12	18	24
0.024-in. (24 gage) sheet metal over 1-in. glass fiber or mineral wool batts reinforced with wire, or equivalent, or rear face with ventilated air space	3	9	15	18	2	6	8	12	16
3 1/2-in. thick masonry wall with ventilated air space	-	-	-	-	2	6	8	12	16
0.024-in. (24 gage) sheet metal with ventilated air space	3	9	15	18	2	6	8	12	16
1/2-in. thick noncombustible insulation board with ventilated air space	3	9	15	18	2	6	8	12	16
0.024-in. (24 gage) sheet metal with ventilated air space over 0.024-in. (24 gage) sheet metal with ventilated air space	3	9	15	18	2	6	8	12	16
1-in. glass fiber or mineral wool batts sandwiched between two sheets 0.024-in. (24 gage) sheet metal with ventilated air space	3	9	15	18	2	6	8	12	16

¹ Spacers and ties shall be of noncombustible material. No spacers or ties shall be used directly behind appliance or conductor.

² With all clearance reduction systems using a ventilated air space, at least two sides of the protection shall be open to provide adequate air circulation. There shall be at least one inch between the clearance reduction system and combustible walls and ceilings.

³ Mineral wool bats, blanket or board shall have a minimum density of 8 lb. per cubic foot and have a minimum melting point of 1,500°F.

⁴ Insulation material used as part of a clearance reduction system shall have a thermal conductivity (k) of One (Btu) (in)/(Sq. ft.) (Hr.) (°F) or less. Insulation board shall be formed of noncombustible material.

⁵ If a single wall connector passes through a masonry wall used as a wall shield, there shall be at least 1/2 inch of open, ventilated space between the connector and the masonry.

⁶ Clearances in front of the loading door or ash removal door of the appliance shall not be reduced.

FIGURE 23.045-B

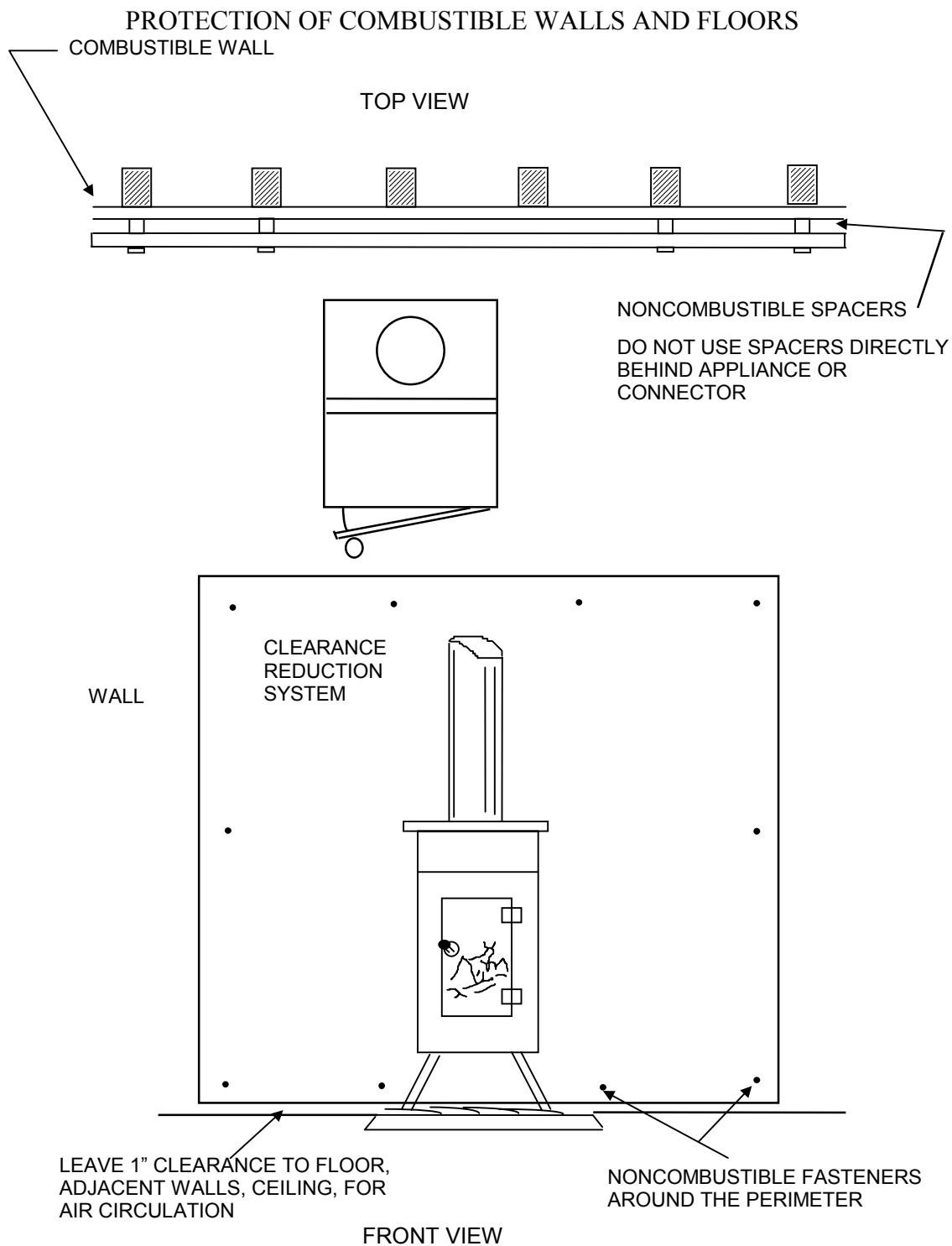
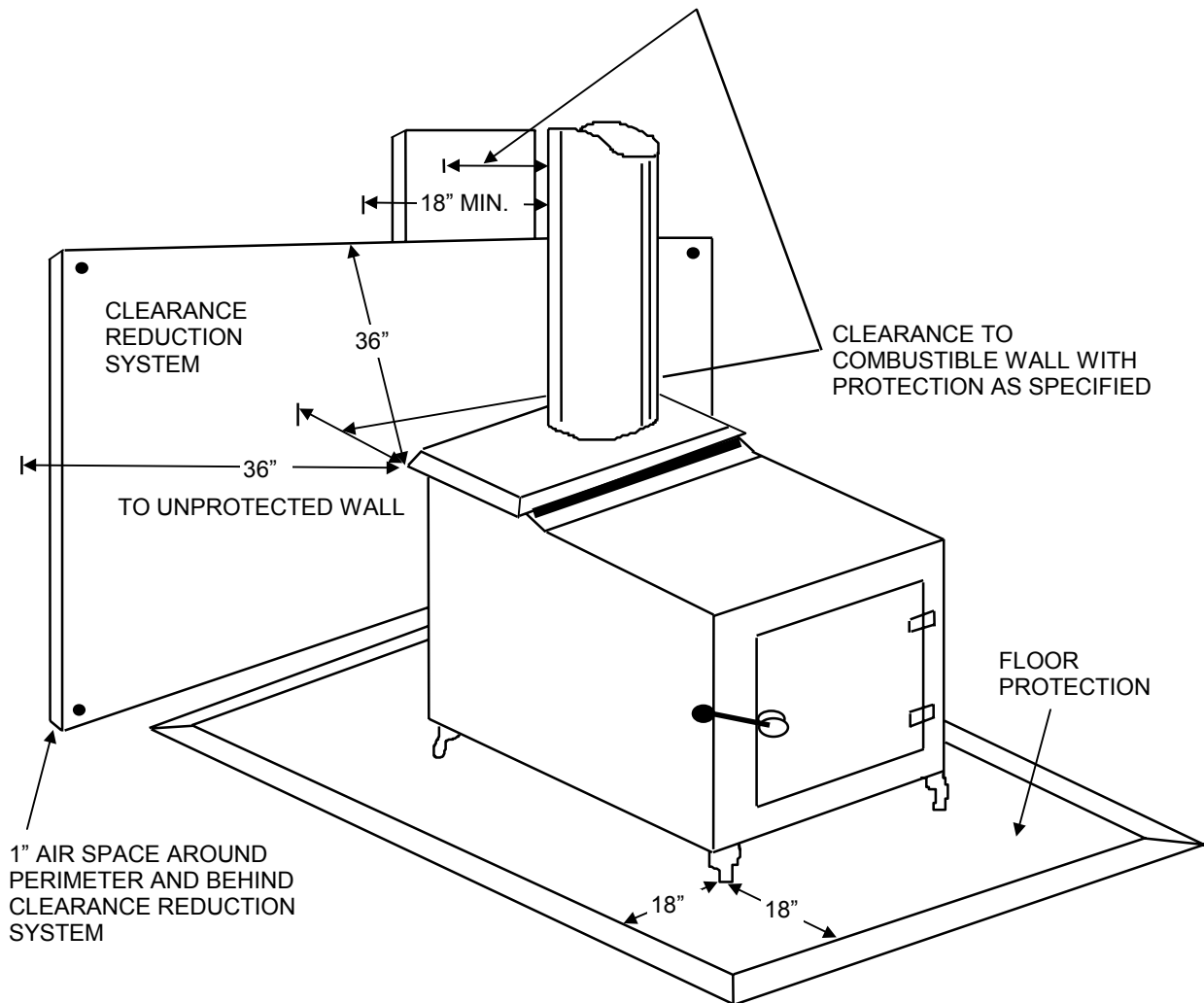


FIGURE 23.045-B (continued)



Clearances

The requirement for proper clearances in this section refers to clearances to combustibles. It should be remembered that an appliance still needs to comply with s. Comm 23.045(2) for the proper servicing clearances.

It is important to keep in mind that a wood-frame wall with drywall or plaster finish is still considered a combustible wall for determining appliance and smokepipe clearances. Heat is readily conducted to the studs underlying the drywall. Over a period of time, the ignition temperature of the wood decreases as it is dried out and chemically changed. Noncombustible surface protection is only effective if there is at least a 1-inch air space between it and the combustible construction.

(7) ACCESSORIES. Accessories for solid-fuel-burning appliances such as heat exchangers, stove mats, floor pad and protection shields, shall be listed and shall be installed in accordance with the terms of their listing.

(8) SUPPLEMENTAL UNITS. Supplemental solid-fuel-burning units connected to a furnace shall be connected to the warm air side of the furnace as illustrated in Figures 23.045-C to E.

(a) Return air duct. The area of the return air duct shall be at least equal to the area of the warm air supply duct. The return air duct shall be of the same material as specified for supply air ducts. Return air grilles shall not be located in bathrooms, kitchens, garages, utility spaces or in a confined space defined under s. Comm 23.06 in which a draft diverter or draft regulator is located.

(b) Blower. The blower on the furnace shall maintain the manufacturer's specifications for cubic feet per minute air flow and static pressure when the supplemental unit is in operation.

(c) Outside air intake. The outside air intake shall be connected to the cold air return plenum of the furnace. A volume damper shall be placed in the duct for the fresh air intake.

FIGURE 23.045-C

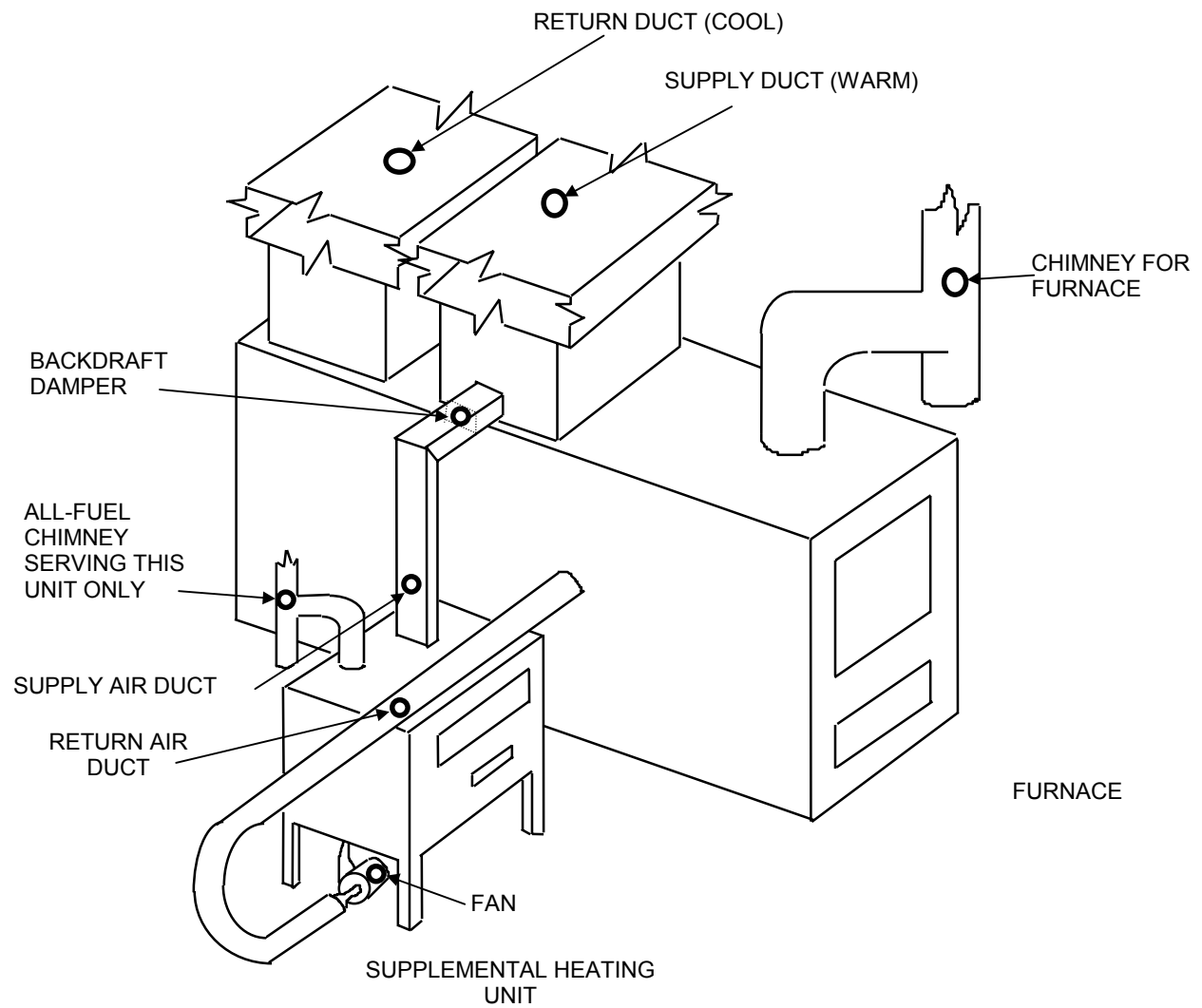


FIGURE 23.045-D

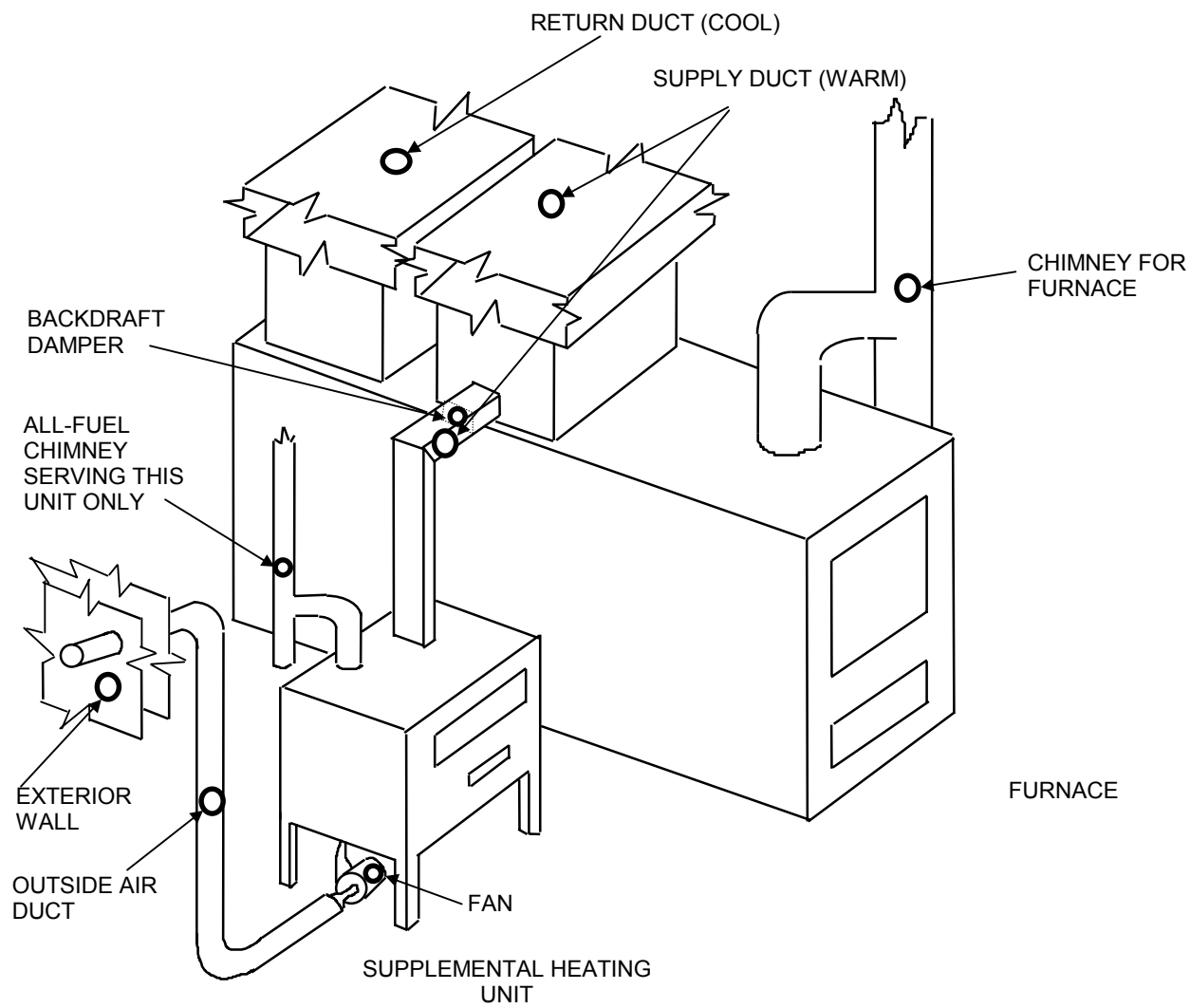
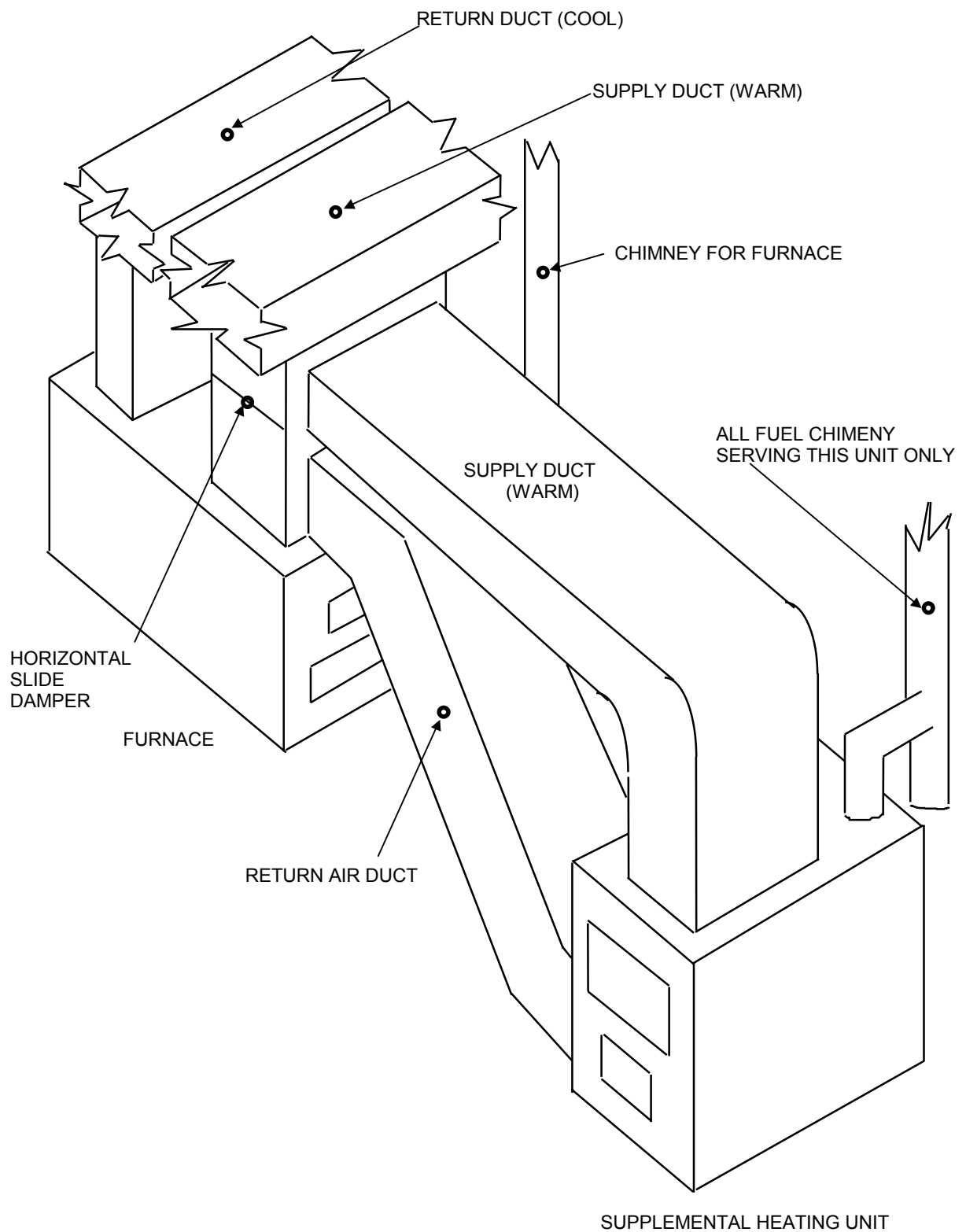


FIGURE 23.045-E



(d) Thermostat. The thermostat control on the supplemental heating unit shall activate the blower motor at a temperature between 100° and 120° F.

(e) Supplemental units. Supplemental solid-fuel-burning units shall be installed to maintain a 3-foot clearance between the unit and the furnace or shall be installed in accordance with the listings of both the supplemental unit and the furnace if such an installation is specifically covered by the listings.

(9) SUPPLY DUCTS. Supply ducts connected to solid-fuel-burning appliances shall have the following minimum clearances to combustibles:

(a) Horizontal ducts. The clearance from combustibles for horizontal ducts shall be as specified in Table 23.045-F.

TABLE 23.045-F

Distance of Ducts From Bonnet or Plenum (inches)	Clearance to Combustibles ¹ Required (inches)
0 to 36	18
over 36 to 72	6
over 72	1

¹ Clearance can be reduced in accordance with Table 23.045-B

(b) Vertical ducts. 1. Air shall travel 6 feet and change directions equivalent to one 90° turn before entering an enclosure of combustible material.

2. Ducts shall have 3/16 inch clearance between the duct and any combustible material.

(10) COMBINATION APPLIANCES. Appliances capable of burning multitypes of fuel shall be listed and installed in accordance with their listing.

Combination Appliances

Note that this section requires combination appliances or dual-fuel appliances to be listed for the combination use. If allowed by the listing, the units may be vented by the same flue.

Table 23.045-C specifies the floor mounts for solid-fuel-burning appliances.

Comm 23.05 Safety controls.

High limit, maximum outlet air temperature and similar safety controls shall be provided on heating equipment.

Comm 23.06 Combustion air.

(1) SCOPE. (a) Naturally vented appliances and other appliances that require air for combustion and dilution of flue gases to be taken from within the building shall comply with this section.

(b) Appliances that are provided with a direct supply of outside air for combustion in accordance with the manufacturer's installation instructions and listing are not required to comply with this section.

(c) Where the appliance listing and manufacturer's instructions are more stringent than the provisions of this section, the listing and manufacturer's instructions apply.

(2) METHODS FOR PROVIDING AIR. Air for combustion and dilution shall be provided in accordance with one of the following:

(a) If the vapor retarder is not continuous on walls and ceilings exposed to the outside atmosphere as allowed by s. Comm 22.22, air may be provided from inside the building in accordance with sub. (3).

(b) Air may be provided from outside the building in accordance with sub. (4).

(c) The appliance may be installed in accordance with its listing and manufacturer's instructions. Where all walls and ceilings exposed to the outside atmosphere are provided with a continuous vapor retarder, any requirements for unusually tight construction shall be met.

(d) An engineered system providing an adequate supply of air for combustion ventilation and dilution of flue gases may be installed if approved by the department.

(3) AIR FROM INSIDE THE BUILDING. (a) 1. The equipment shall be located in a space with a volume not less than 50 cubic feet per 1000 Btu/h of the combined input rating of all fuel-burning appliances drawing combustion and dilution air from that space.

2. The space may be made up of more than one room if the rooms are connected through doorways without doors or connected through sets of openings described in par. (b).

(b) 1. When needed to connect rooms, two opening shall be provided, one within 1 foot of the ceiling of the room and one within 1 foot of the floor.

2. The net free area of openings shall be calculated in accordance with sub. (5).

3. The net free area of each opening shall be a minimum of one square inch per 1000 Btu/h of combined input rating of the fuel-burning appliances drawing combustion and dilution air from the communicating rooms, but shall be not less than 100 square inches.

(4) AIR FROM OUTSIDE THE BUILDING. (a) When air for combustion and dilution is provided from outside the building, as allowed under subm. (2) (b), one of the methods specified in pars. (b) to (d) shall be used.

(b) Openings may be provided to connect rooms containing appliances to the outdoors.

1. a. Two openings shall be provided, one within 1 foot of the ceiling of the room and one within 1 foot of the floor.

b. Openings may connect directly to the outdoors or to the outdoors through a horizontal or vertical duct.

c. The net free area of openings shall be calculated in accordance with sub. (5).

2. The net free area of each direct opening to the outdoors not using a duct shall be a minimum of one square inch per 4000 Btu/h of combined input rating of the fuel-burning appliances drawing combustion and dilution air from the room.

3. a. The net free area of each opening connected to the outdoors through a horizontal duct shall be a minimum of one square inch per 2000 Btu/h of combined input rating of the fuel-burning appliances drawing combustion and dilution air from the room.

b. The cross-sectional area of the duct shall be equal to or greater than the required size of the opening.

4. a. The net free area of each opening connected to the outdoors through a vertical duct shall be a minimum of one square inch per 4000 Btu/h of combined input rating of the fuel-burning appliances drawing combustion and dilution air from the room.

b. The cross-sectional area of the duct shall be equal to or greater than the required size of the opening.

(c) 1. Where all appliances drawing air for combustion and dilution from the room are gas appliances, air may be provided via a single opening to connect the room to the outdoors in accordance with this paragraph.

2. a. The opening shall be located within 1 foot of the ceiling of the room.

b. The opening may connect directly to the outdoors, may connect to the outdoors through a horizontal duct, or may connect to the outdoors through a vertical duct.

c. The net free area of opening shall be calculated in accordance with sub. (5).

3. a. The net free area of the opening shall be a minimum of one square inch per 3000 Btu/h of combined input rating of the fuel-burning appliances drawing combustion and dilution air from the room, and not less than the combined cross-sectional flow areas of the appliance flue collars or draft hood outlets.

b. The cross-sectional area of the duct shall be equal to or greater than the required size of the opening.

4. The appliances shall have a minimum clearance to the surfaces of the room of 1 inch at the sides and back of the appliance and 6 inches at the front of the appliance.

(d) 1. A combination of openings to the outside and openings to other rooms may be used in accordance with this paragraph.

2. a. One opening shall connect directly to the outdoors, connect to the outdoors through a horizontal duct, or connect to the outdoors through a vertical duct.

b. The net free area of the opening shall be calculated in accordance with sub. (5).

c. The net free area of the opening shall be a minimum of one square inch per 5000 Btu/h of combined input rating of the fuel-burning appliances drawing combustion and dilution air from the room.

d. The cross-sectional area of a duct, if used, shall be equal to or greater than the required size of the opening.

3. a. The equipment shall be located in a space with a volume not less than 50 cubic feet per 1000 Btu/h of the combined input rating of all fuel-burning appliances installed in that space.

b. The space may be made up of more than one room if the rooms are connected through openings without doors or connected through sets of openings described in subd. 3.

4. a. When needed to connect rooms, two openings shall be provided, one within 1 foot of the ceiling of the room and one within 1 foot of the floor.

b. The net free area of openings shall be calculated in accordance with sub. (5).

c. The net free area of each opening shall be a minimum of one square inch per 1000 Btu/h of combined input rating of the fuel-burning appliances drawing combustion and dilution air from the communicating rooms, but shall be not less than 100 square inches.

(5) NET FREE AREA CALCULATION. (a) The required size of openings for combustion and dilution air shall be based on the net free area of each opening.

(b) The net free area of an opening shall be that specified by the manufacturer of the opening covering or by a source approved by the department.

(c) In the absence of such information, openings covered with metal louvers shall be deemed to have a net free area of 75 percent of the area of the opening, and openings covered with wood louvers shall be deemed to have a net free area of 25 percent of the area of the opening.

(6) INTERLOCKING OF DAMPERS. (a) Where the combustion air openings are provided with volume, smoke or fire dampers, the dampers shall be electronically interlocked with the firing cycle of the appliances served, so as to prevent operation of any appliance that draws combustion and dilution air from the room when any of the dampers are closed.

(b) Manually operated dampers shall not be installed in combustion air openings.

(7) SIMULTANEOUS OPERATION. (a) The equipment and appliances within every room containing fuel-burning appliances shall be installed so as to allow the free circulation of air.

(b) Provisions shall be made to allow for the simultaneous operation of mechanical exhaust systems, fireplaces, clothes dryers or other equipment and appliances operating in the same room or space from which combustion air and dilution air is being drawn. The provisions shall prevent the operation of the appliances, equipment and systems from affecting the supply of combustion and dilution air.

Note: Wood typically has a heating value of 8600 BTU per pound.

Combustion Air for Wood Stoves

Question: *Comm 23.045(2)(b). How do I calculate if a wood stove needs outside combustion air because of small room size?*

Answer: *If the appliance is listed, then an hourly input rating is given and the calculation is straightforward. An unlisted appliance's hourly input BTU rating can be figured on the following basis:*

$$\begin{aligned} \frac{\text{BTU input}}{\text{hr.}} &= C \times 60\% (\% \text{ firebox fill}) \times \frac{40 \text{ lbs. wood}}{\text{Cu. ft.}} \times \frac{8600 \text{ BTU}}{\text{lb. wood}} \times \frac{1 \text{ firebox full}}{2 \text{ hrs.}} \\ &= \frac{103,200 \text{ BTU/HR}}{\text{cu. ft.}} \times C \end{aligned}$$

where: $C = \text{firebox capacity (cu. ft.)} = l \times w \times h$
 $= \text{product of inside firebox dimensions in feet.}$

Combustion Air

The code offers several methods to supply adequate combustion air. Below is a highlighted listing of the options. Also see the optional Makeup and Combustion Air Worksheet at the end of this chapter.

Method 1. Inside Air (Discontinuous Vapor Retarder) (23.06(3)): Allows combustion air to be drawn from an inside space if the building has a discontinuous vapor barrier, as is permitted at boxsills or below grade walls by s. 22.22. The space shall provide a room volume of at least 50 cubic feet per 1000 btu/hr combined input rating of all open combustion appliances in that space. An inside space may include several rooms if connected with high and low openings, with each opening providing one square inch of clear opening per 1000 btu/hr input rating, but not less than 100 square inches each.

Method 2. Inside & Outdoor Air (Continuous Vapor Retarder) (23.06(4)(d)): If a building has a continuous vapor barrier, and therefore cannot use the method of 23.06(b) of taking all air from inside, but does have a room volume of at least 50 cubic feet per 1000 btu/hr combined input rating of all open combustion appliances in that space, then it can use a method of supplementing the inside air with outside air. It shall be via a single, direct or ducted, exterior, high opening, sized at one square inch per 5,000 btu/hr combined input rating.

Method 3. Single Outdoor Opening (Gas Appliances Only) (23.06(4)(c)): If serving only gas appliances, then from outdoors via a single, direct or ducted, exterior, high opening sized at one square inch per 3,000 btu/hr combined input rating, but not less than the combined cross sectional areas of the appliance flue collars or draft hood outlets in that space.

Method 4. Prorated Inside Air Credit Plus Outdoor Air (23.06(2)(d)): For method 1, per current national standards (1999 NFPA 54-5.3.3(c)), we will also allow a combination of drawing inside and outside combustion air, unless prohibited by the appliance manufacturer. This is done by taking a pro-rated credit for an inside space that partially meets method 1, and then making up the difference by pro-rating the outside combustion air otherwise required by Method 5 (23.06(4)(c)). Example: If the inside space provides only 25 cubic feet per 1,000 btus, or half of the size required by method 1, then the additional direct or ducted outside combustion air, as calculated by method 5 can be reduced by one half.

Method 5. Two Outdoor Openings (23.06(4)(b)): From outdoors via high and low direct or vertically ducted exterior openings, each sized at one inch per 4,000 btu/hr combined input rating or via horizontally ducted openings, each sized at one inch per 2,000 btu/hr combined input rating.

EXAMPLE:

1. Determine if the space in which the heating appliances are located is large enough to supply combustion air by itself per Method 1 per s. Comm 23.06(3).
 - a. The plans indicate a utility room will be constructed which houses a:
 - (1) Gas-fired furnace (100,000 BTU input).
 - (2) Gas-fired water heater (33,000 BTU input).

b. The utility room size is approximately 12 ft. long by 5.5 ft. wide. This is 66 sq. ft. in area. The rest of the basement is 934 sq ft. in area.

The "Typical Section" drawing shows the room height to be 7 ft. 6 in. plus the depth of the floor joists 9 1/4 in. Therefore, the height then becomes 8.33 ft. The section also indicates that the vapor retarder is omitted on the boxsill, so s. Comm 23.06(3) may be used.

The volume of the room equals 66 sq. ft. times 8.33 ft. or 549 cu. ft.

c. The minimum room volume on the basis of the equation in s. Comm 23.06(3) is:

$$\text{Room Volume} = \frac{100,000 \text{ BTU furnace} + 33,000 \text{ BTU water heater}}{1,000} \times 50 \text{ cu ft} = 6650 \text{ cu ft}$$

Since the 549 cu. ft. is smaller than 6650 cu. ft., the utility room is too small and another method of supplying combustion air must be used.

2. Try Method 1 again, but draw combustion air from the whole basement via openings in the utility room walls.

a. The volume of the room equals 1000 sq. ft. times 8.33 ft. or 8333 cu. ft. which satisfies the calculated required volume of 6650 cu ft above.

b. Two openings are required (high and low), each sized as follows:

$$\text{Opening Area} = \frac{(100,000 \text{ BTU} + 33,000 \text{ BTU})}{1,000} = 133 \text{ sq. in.}$$

c. This also satisfies the requirement for a minimum 100 sq in openings. (Two 1-sq. ft. = 144 sq.in. openings would suffice.)

OR

3. Try Method 3 per s. Comm 23.06(4)(c) Single Outdoor Opening between the utility room and the exterior. Since the appliances are all gas-fired, this method may be used. (We could take a prorated credit per Method 3 of s. Comm 23.06(2)(d) for the utility room, but because of its smallness, we will not bother in this example.)

a. The minimum size of the single opening is determined as follows:

$$\text{Opening Area} = \frac{133,000 \text{ BTU}}{3,000} = 44 \text{ sq. in.}$$

b. An 8" round duct, which provides 50 sq in, would satisfy this. However, you must also check that the combined flue collar areas of the appliances would be met:

The water heater has a 3" diameter collar which is $3.14(1.5^2) = 7\text{sq in. in area.}$

The furnace has a 6" diameter collar which is $3.14(3^2) = 28\text{sq in. in area.}$

The combined area is $7\text{sq in} + 28\text{sq in} = 35\text{sq in} - \text{OK}$

c. Consideration should be given to the blocking effect of screens and louvers in air intake openings. Assuming 1/8" screen, multiply the 50 sq in of the 8" diameter duct by 0.8 to arrive at 40 sq. in., which still satisfies the requirement.

Comm 23.062 Mechanical draft systems.

Where a mechanical draft system, such as a fan is used, provision shall be made to prevent the flow of gas to the main burners when the draft system is not performing so as to satisfy the operating requirements of the system for safe performance.

Comm 23.065 Equipment maintenance information.

Required regular maintenance actions for equipment shall be clearly stated and incorporated on a readily accessible label. The label may be limited to identifying, by title or publication number, the operation and maintenance manual for that particular model and type of equipment. Maintenance instructions shall be furnished for equipment which requires preventive maintenance for efficient operation. Manufacturer's manuals for all installed heating and cooling equipment and service water heating equipment shall be provided.

Subchapter IV — Delivery Systems

Comm 23.07 Air distribution systems.

(1) SIZING. All air distribution systems shall be sized using the velocities and static pressure losses listed in Table 23.07.

TABLE 23.07
DUCT VELOCITIES

Designation	Maximum Static Pressure Loss (in WG/100 feet)	Minimum Velocity (feet/minute)	Maximum Velocity (feet/minute)
Main trunk duct	.10	700-900	800-1200
Branch duct	.10	600	700-1000
Branch riser	.10	500	650-800
Outdoor intake	.10	500	800
Grilles or openings	.10	400	600
Return air door undercuts	.10	200	300
Wall louvers	.10	200	300

WG = Water gauge per 100 feet.

(2) **SYSTEM SIZING.** The distribution system, including the evaporator coil, air filters (installed external to the heating unit), ducts, fittings, grilles and registers, shall be sized so that the total external static pressure shall not exceed the static pressure capacity of the fan at the system rated air flow.

(3) **CHANGES IN DUCT SIZE.** Where duct sizes are changed, the slope angle of the transition duct shall not exceed 45°.

Comm 23.08 Ductwork.

(1) **DUCT USE.** Ducts designed for the transmission of air shall be used for no other purpose.

Ducts Used for Other Purposes

Question: *Can electrical, telephone or cable TV wiring be run through air return or supply ducts? Can supply ducts be run through air return ducts or joist spaces used as returns?*

Answer: *No, with three exceptions per National Electrical Code 300-22:*

- *Teflon-insulated wiring.*
- *Metal enclosed wiring.*
- *Romex wiring run perpendicularly to the length of a joist or stud space used as a return air plenum.*

*The department will also allow water and waste piping run perpendicularly through a duct if no pipe joints or cleanouts are within the duct. All penetrations have to be sealed to maintain duct pressures and prevent air leakage. In addition the size of the penetrating utility through the duct can **NOT** effect the velocity or capacity of the duct to transmit the required air volumn of the duct.*

(2) **INTERIOR DUCTS.** All interior ducts shall be constructed in accordance with the following:

(a) **Supply and return air ducts.** Supply and return air ducts shall comply with this paragraph except that ducts attached to appliances may be constructed of materials specified in the appliance listing.

1. Kitchen exhaust ducts and ducts for air exceeding 250°F shall be constructed of sheet metal or lined with sheet metal or constructed of other noncombustible noncorrugated materials.

2. Ducts connected to furnaces shall be constructed of sheet metal for at least 6 feet from the furnace.

3. Spaces formed by unlined wood joists, studs or wood I-joists with solid webs may be used as return air ducts. Spaces used as return air ducts shall be cut off from all remaining unused portions of the space by tight-fitting stops of sheet metal or of wood joist material. Bridging shall be removed from the joist space.

(b) Under-floor plenums. An under-floor space may be used as a plenum in a single dwelling unit in accordance with this section.

1. The use of the under-floor space shall be limited to buildings not more than 2 stories in height. Except for the floor immediately above the under-floor plenum, supply ducts shall be provided extending from the plenum to registers or other floor levels.

2. The under-floor spaces shall not be used for storage, shall be cleaned of all loose scrap material and shall be tightly and substantially enclosed.

3. The enclosing material of the under-floor space, including the side wall insulation and vapor barriers, shall not be more flammable than one-inch (nominal) wood boards (flame spread classification of 200).

4. Access shall be through an opening in the floor which shall be 18 inches by 24 inches.

5. The furnace supplying warm air to the under-floor space shall be equipped with an automatic control which will start the air circulating fan when the air in the furnace bonnet reaches a temperature not higher than 150° F. Such control shall be one that cannot be set higher than 150° F.

6. The furnace supplying warm air to the under-floor space shall be equipped with an approved temperature limit control that will limit outlet air temperature to 200° F.

7. A noncombustible receptacle shall be placed below each floor opening into the air chamber. The receptacle shall be securely suspended from the floor members and shall be not more than 18 inches below the floor opening. The area of the receptacle shall extend 3 inches beyond the opening on all sides. The perimeter of the receptacle shall have a vertical lip at least one inch high at the open sides if it is at the level of the bottom of the joist, or 3 inches high if the receptacle is suspended.

8. Floor registers shall be designed for easy removal to permit access for cleaning the receptacles.

9. Exterior walls and interior stud partitions shall be firestopped at the floor.

10. Each wall register shall be connected to the air chamber by a register box or boot.

11. A duct conforming to par. (a) shall extend from the furnace supply outlet at least 6 inches below combustible framing.

12. The entire ground surface and enclosing exterior walls of the under-floor space shall be covered with a vapor barrier having a vapor permeability rating of one perm or less and a flame spread rating of 200 or less.

13. Fuel gas lines may not be located within the under-floor space.

14. A smoke detector shall be placed in the under-floor space. The alarm and low-battery signal of the smoke detector shall be audible in the occupied areas of the dwelling, when actuated.

15. The exterior walls of the under-floor spaces shall be insulated in accordance with subch. VI of ch. Comm 22. The insulation may not be omitted under the provisions of s. Comm 22.21 or subch. VII of ch. Comm 22.

16. Electrical wiring installed in the plenum shall be in conformance with the Wisconsin Administrative Electrical Code Volume 2.

(3) EXTERIOR DUCTS. (a) General. Except as provided in par. (b), ducts, which are located in garages, storage attics and similar spaces susceptible to physical damage, shall be constructed of galvanized steel or corrosion-resistive metal.

(b) Exception. Plastic may be used for bath fan or air-to-air heat exchanger exhaust runs located in spaces outside the dwelling.

(4) UNDERGROUND DUCTS. Ducts, plenums and fittings constructed of metal encased in concrete or ceramic, or other approved materials, may be installed in the ground. Supply air ducts shall be insulated with a moistureproof material having a resistance value of at least R-5.

Underground Ducts

The department has approved various PVC coated metal ducts for underground use without concrete encasement. Please contact the state UDC program for specific approval information (contact information is on page i of this commentary preface).

(5) DUCT CONSTRUCTION. Ductwork shall be constructed and installed in accordance with any one of the appropriate following standards:

- (a) ASHRAE Handbook HVAC Systems and Equipment.
- (b) SMACNA, Residential Comfort System Installation Standards Manual.
- (c) SMACNA, HVAC Duct Construction Standards-Metal and Flexible.
- (d) SMACNA Fibrous Glass Duct Construction Standards.
- (e) ASHRAE HVAC Applications Handbook.
- (f) NAIMA Fibrous Glass Duct Construction Standards.

(6) **THICKNESS.** Sheet metal ducts shall conform to the minimum thicknesses listed in Table 23.08-A.

(7) **DUCT SUPPORT.** Ductwork shall be fastened in place and braced to prevent lateral displacement in accordance with Table 23.08-B.

Question: *Is there a maximum length of “flex-duct” that is allowed by the Code?*

Answer: *No, many people feel that since the Commercial Code limits duct length, the UDC also should. There is no maximum length in the Code; however, you must not exceed the static pressure loss in Table 23.07 for air distribution systems. Therefore, from a practical standpoint, flex-ducts will need to be less than 10-14 feet. In no case shall the minimum/maximum velocities or the maximum static pressures be exceeded.*

For exhaust fans, it may be necessary to increase the fan capacity if the static pressure is excessive due to a restrictive duct system.

TABLE 23.08-A

DUCT CONSTRUCTION MINIMUM SHEET METAL GAUGES

	Minimum thickness galvanized sheet gauge	Minimum thickness aluminum B & S gauge
Metal gauges (duct not enclosed in partitions)		
<u>Round Ducts</u>		
Diameter, inches		
Less than 12	30	26
12-14	28	26
15-18	26	24
Over 18	24	22
<u>Rectangular Ducts</u>		
Width, inches		
Less than 14	28	24
14-24	26	22
25-30	24	22
Over 30	22	20
Metal gauges (ducts enclosed in partition)		
Width, inches		
14 or less	30	26
Over 14	28	24

TABLE 23.08-B

DUCT SUPPORT MATERIAL

Duct Type	Maximum Size of Diameter (inches)	Duct Position	Hanger or Strap Size and Spacing
Circular	10	Vertical	No. 18 gauge galvanized steel x 2" @ 12' o.c.
		Horizontal	No. 30 gauge galvanized steel x 1" or No. 18 steel wire @ 10' o.c.
	20	Vertical	No. 16 gauge galvanized steel x 2" @ 12' o.c.
		Horizontal	No. 28 gauge galvanized steel x 1" or No. 18 steel wire @ 10' o.c.
Rectangular ¹	24	Vertical	1" x 1/8" steel galvanized strap @ 12' o.c.
		Horizontal	No. 18 gauge galvanized steel x 1" @ 10' o.c.
		Vertical	1" x 1-1/8" galvanized steel angle @ 12' o.c.
		Horizontal	1" x 1/8" galvanized steel strap @ 10' o.c.

¹ Rectangular metal duct supports should consist of one hanger attached to one-inch wide circular bands of the duct extending around and supporting ducts exceeding 10 inches in diameter.

Note: This table does not prohibit nailing for duct support.

(8) JOINTS AND SEAMS. All joints and seams shall be securely fastened or locked. Round pipe slip joints shall be lapped at least one inch.

(9) VIBRATION CONTROL. When used, vibration isolation connectors shall be installed at the joint between the duct and fan or heating equipment. Vibration isolation connectors shall not be used where the air temperature is in excess of 250° F.

(10) AIR PASSAGEWAYS OF ENVELOPE DWELLINGS. The air passageways of envelope type dwellings shall comply with this subsection.

- (a) No heating equipment shall be placed in the air passageways.
- (b) Wood exposed to the air passageways shall be of at least 2 inches nominal thickness.
- (c) Finishes and insulation exposed to the air passageway shall have a flame spread rating of 25 or less and a smoke development rating of 50 or less.
- (d) A vapor barrier shall be installed on the warm side of insulation which forms a part of the thermal envelope of the dwelling. In the roof-ceiling air passageway, a vapor barrier for the insulation of the ceiling may be omitted if heated air is circulated on both sides of the ceiling insulation. The insulation on the roof side of the air passageway shall be provided with a vapor barrier on the warm side of the insulation. Any vapor barrier exposed to circulating air shall have a flame spread rating of 25 or less and a smoke development rating of 50 or less.

Note: Also see s. Comm 21.08 (1m), Equivalent Firestopping Requirements for Envelope Dwellings.

Comm 23.09 Dampers, registers and grilles.

(1) **VOLUME AND BACKDRAFT DAMPERS.** Volume duct dampers shall be provided to permit balancing of the system. No supply ducts shall terminate in a garage without a backdraft damper.

*Register dampers **do not** satisfy the requirement for volume duct dampers due to their looseness.*

If duct volume dampers will be concealed behind finish materials, access panels shall be provided to allow future adjustment. Alternatively, dampers may be placed behind registers, which could be removed for future access to the dampers.

2) **AIR REGISTERS AND GRILLES.** (a) Supply air registers. All supply air outlets shall be provided with registers or devices which will provide a uniform distribution of air.

(b) Return air grilles. Return air grilles shall not be located in bathrooms, kitchens, garages, utility spaces or a confined space in which a draft diverter or draft regulator is located. All other habitable spaces shall have permanent openings to a return air grille equal in area to the supply outlet serving those areas. At least one return air opening shall be provided for each floor.

Return Air Openings

Question: *Is it necessary to have a return air opening in each room that has a supply air opening?*

Answer: *No. If doors are undercut or other air transfer means are provided, it would not be necessary to have a return air opening in each room. However, the air must at least be transferred to a return duct serving the same floor level.*

Question: *In a two-story house, may a return air grille, at the base of the stairs to the second floor, serve the second floor? (Can the stairway serve as a return air system?)*

Answer: *No. Per this code section there must be return grilles located on both floors.*

Comm 23.10 Piping.

(1) PIPE SIZES AND ARRANGEMENT. All steam and hot water supply and return piping, air-line piping and auxiliary equipment shall be of appropriate sizes, elevations and arrangements to accomplish the calculated results without stress or other detriment.

Note: The sizes of pipe to be used for mains and risers may be selected from the ASHRAE Guide and Data Book, published by the American Society of Heating, Refrigerating and Air Conditioning Engineers; or the manuals published by the Institute of Boiler and Radiator Manufacturers or the Mechanical Contractors Association of America.

(2) EXPANSION AND CONTRACTION. The piping for the heating system shall be equipped with anchors, expansion swings or joints, supports and similar devices to relieve stress and strain caused by temperature change of the pipe material.

(3) PIPE INSULATION. Unguarded steam, hot water supply and return piping shall be covered with insulating material where the pipes pass through occupied areas and the surface temperature exceeds 180° F.

(4) STEAM AND HOT WATER PIPES. No pipe carrying hot water or steam at a surface temperature exceeding 250° F shall be placed within one inch of any combustible material, pass through a combustible floor, ceiling or partition unless the pipe is protected by a metal sleeve one inch larger in diameter than the pipe or with approved pipe covering.

(5) BALANCING. Balancing cocks shall be provided in each circuit of a hot water distribution system.

Solar System Piping

Question: *Can PVC (plastic) piping be used in a solar wet-heat system?*

Answer: *Section Comm 23.10 addresses the subject of piping for wet-heating systems. However, this section does not speak specifically to the kind of piping materials. It only says that the material shall accomplish the calculated results without stress or other detriment..*

This section is also supplemented by s. Comm 71.25, Liquid Systems, of the Solar Energy Systems Code which became effective July 1, 1986. The Solar Energy Systems Code includes voluntary construction quality standards for solar collectors and their supporting mechanical systems.

Section Comm 71.25 does allow plastic piping for some systems if the material meets s. Comm 84.30 of the Plumbing Code.

Subchapter V — Chimneys and Vents

Comm 23.11 General requirements.

(1) **TYPES OF CHIMNEYS AND VENTS.** All heating appliances using solid, liquid or gas fuels shall be vented to the outside by an all-fuel factory-built, masonry chimney or other listed venting system designed to remove the products of combustion.

Chimney and Vent

See following table summarizing common vent and chimney types.

Power Venters

Question: *Can power-vented appliances be used?*

Answer: *Yes. There are two types of power-vented appliances. One type is designed, manufactured and listed as a unit. These are installed per their listing.*

The second type is an add-on power venter designed and manufactured by a manufacturer other than the appliance manufacturer. These units must either be tested and listed for connection to a specific appliance model or have received a Wisconsin Materials Approval. Wisconsin approval has been given to the Tjernlund, Inc., and Field Controls, Inc., power venters.

Coventing with either type must be done strictly per their listing because of possible backdrafting and variable pressure conditions.

(2) **TERMINATION.** (a) **Chimneys.** All listed factory manufactured chimneys depending on a principle of gravity for the removal of the products of combustion shall terminate at the location specified in the product listing. For masonry chimneys or where termination location is not specified as a part of the listing, the chimney shall extend at least 3 feet above the highest point where the chimney passes through the roof of the building, and at least 2 feet higher than any ridge, peak, wall, or roof within 10 feet horizontally of the chimney.

(b) **Vents.** Gas and oil appliance vents shall terminate in locations specified in their listings.

(3) **SIZING.** Vents for new or replacement equipment shall be sized to adequately exhaust combustion products from the dwelling.

Note: The department recommends vent sizing in accordance with NFPA 54, National Fuel Gas Code or its appendix.

Horizontal Vent Termination

Question: *What is required for vent sizing when multiple appliances share a common vent and equipment is changed or replaced?*

Answer: *Gas vents are to be sized for the appliances currently connected to them. Therefore, if the new equipment is either larger or smaller, the vent may have to be altered in size. This would apply to all UDC homes including replacement equipment.*

Comm 23.12 Masonry chimneys.

Masonry chimneys shall conform to the requirements of s. Comm 21.30.

Comm 23.13 Factory-built chimneys or vents.

Factory-built chimneys or vents shall be of an approved type.

Note: The department recognizes as approved, factory-built chimneys or vents designated as "residential type and building heating appliance," "building heating appliance," "B," "BW," and "L" types listed by Underwriters' Laboratories, Inc.

(1) RESIDENTIAL TYPE AND BUILDING HEATING APPLIANCE. An approved "residential type and building heating appliance" chimney may be used with liquid or gas-fired heating appliances where the flue gas temperature does not exceed 1000° F continuously, and does not exceed 1400° F for infrequent brief periods of forced firing.

(2) TYPE "B." An approved type "B" gas vent may be used with a vented, recessed wall heater.

(3) TYPE "BW." An approved type "BW" gas vent may be used with a vented, recessed wall heater.

Physical Guarding of Chimneys and Vents

Question: *Does an accessible chimney or vent need to be guarded against physical damage when located in a space like a garage?*

Answer: *Yes, normally a metal chimney usually does require to be guarded as part of its listing. A metal vent may require guarding as part of its listing.*

CHIMNEYS AND VENTS

<u>Classification</u>	<u>Other Names</u>	<u>Cont. °F</u>	<u>Max. °F</u>	<u>Use</u>	<u>Clearance</u>
1. Single-wall metal pipe	Class C	--	--	Only as connector in residence	Per Comm 23.045 and 23.15
2. BW vent	--	550°	--	Wall furnace (2" x 4" wall)	Per listing
3. B vent	Gas vent	470°	--	Listed gas appliance with hood	B-1" to B-3" B-2" x 4", B-2" x 6"
4. L vent	Oil vent	570°	--	Gas or oil appliance per listing	L-1" to L-3"
5. Residential type factory-built chimney	Class A All-fuel Solid-fuel Metal Chimney				
a. Standard	--	1000°	1700°	Gas, oil and solid fuel appliance except closed-chamber solid fuel appliances	1" - 2"
b. HT (High Temperature)	--	1000°	2100°	Includes closed chamber solid-fuel appliances	1" - 2"
6. Masonry chimney with liner		(1000°)	1800°	the above	1/2" - 2" (21.30(9))
7. Factory-built fireplace and chimney package	--	--	--	Per listing	Per listing

Comm 23.14 Gas vents.

(1) GENERAL. All gas-fired equipment shall be provided with vent pipes conforming with s. Comm 23. 15 (2) (e), unless the manufacturer specifies other materials.

(2) DRYER VENTING. (a) Gas-fired clothes dryers shall be provided with metal venting that terminates outside the structure.

Note: s. Comm 22.08 (3) requires all dryer venting to terminate outside the structure.

(b) Where dryer vent piping is concealed, a rigid metal vent pipe conforming with s. Comm 23.15 (2) (e) shall be used.

Question: *May plastic vent pipe or flex-vent be used for clothes dryers?*

Answer: *Probably not. Comm 23.14 (2) requires gas-fired clothes dryers to be vented to the exterior with metal vent pipe. If the vent piping is concealed, then it shall be rigid metal. Most manufacturers of even electric clothes dryers also recommend metallic vents; however, some still allow plastic vents to be used.. Due to various safety and fire hazards, the department recommends metal for all dryers that way if equipment is changed out later to a gas dryer it would still be compliant.*

(3) VENTING SYSTEM LOCATION. (a) A venting system shall terminate at least 3 feet above any forced air inlet located within 10 feet horizontally. This provision does not apply to the combustion air intake of a direct-vent appliance.

(b) The venting system of other than a direct-vent appliance shall terminate at last 4 feet below, 4 feet horizontally from, or 1 foot above any door, window, or gravity air inlet into any building. The bottom of the vent shall be located at least 12 inches above grade.

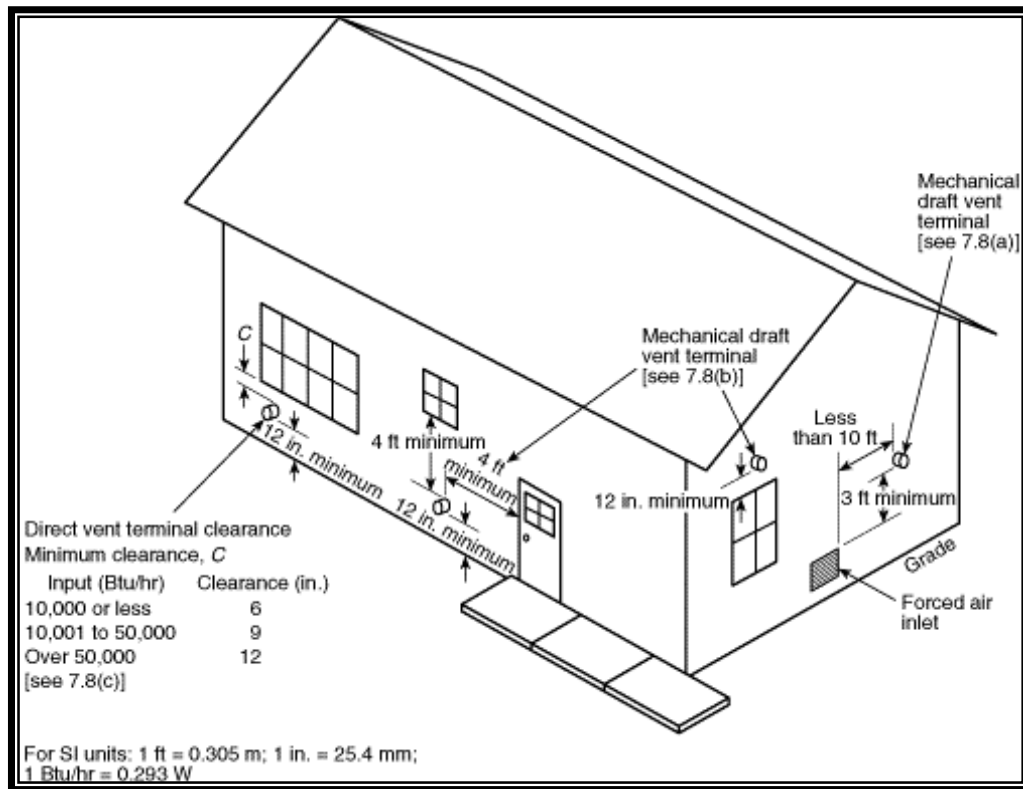
(c) The vent terminal of a direct-vent appliance with an input of 10,000 Btu/h or less shall be located at least 6 inches from any air opening into a building.

(d) The vent terminal of a direct-vent appliance with an input over 10,000 Btu per hour but not over 50,000 Btu/h shall be located at least 9 inches from any air opening into a building.

(e) The vent terminal of a direct-vent appliance with an input over 50,000 Btu/h shall be located at least 12 inches from any air opening into a building.

(f) The bottom of the vent terminal and the air intake of a direct-vent appliance shall be located at least 12 inches above grade.

(g) The exit terminal of a mechanical draft system shall be not less than 7 feet above grade where located within 3 feet of a public walkway that is intended for use by the general public.



Comm 23.15 Chimney connectors, smoke pipes and stovepipes.

(1) DEFINITION. Chimney connectors, smoke pipes or stovepipes are passages for conducting the products of combustion from a fuel-fired appliance to the chimney.

(2) CONSTRUCTION AND INSTALLATION. The construction and installation of chimney connectors of solid-fuel-burning appliances shall comply with s. Comm 23.045 (4). The chimney connectors of all other fuel-fired appliances shall conform with the following requirements:

(a) Concealed space. No chimney connector shall pass through any outside window, door or combustible outside wall, nor be concealed in any closet, attic or similar space.

(b) Combustible partitions. Connectors for appliances shall not pass through walls or partitions constructed of combustible material unless they are guarded at the point of passage by:

1. Metal ventilated thimbles not less than 12 inches larger in diameter than the connector;
2. Metal or burned fireclay thimbles built in brickwork or other approved fireproofing materials extending not less than 8 inches beyond all sides of the thimble.

(c) Pitch and length. Chimney or vent connectors shall have no more than two 45° offsets with the vertical. The horizontal length shall not exceed 75% of the total vertical height of the

total venting system measured from the appliance outlet. Chimney or vent connectors shall be pitched at least 1/4 inch per foot from the appliance outlet collar vent to the chimney inlet.

(d) Dampers. 1. Manually operated dampers are prohibited in chimney or vent connectors of all appliances except wood-burning appliances.

2. A listed, automatically operated damper may be used with any heating appliance provided it is installed and used in accordance with the appliance and damper listing.

(e) Materials and thickness. Chimney or vent connectors serving liquid fuel or gas appliances shall conform to the type of material and thickness indicated in Table 23.15-A or 23.15-B.

(f) Clearance. Single wall metal connectors shall be installed with clearance to combustibles as indicated in Table 23.15-C. These clearances may be reduced if the combustible material is protected in accordance with the requirements of Table 23.04-B.

TABLE 23.15-A

MINIMUM CHIMNEY CONNECTOR GAUGES FOR OIL-FIRED APPLIANCES		
Diameter of Connector	Galvanized Steel Gauge Number	
	Min. thickness (inch)	Gauge
Less than 6 inches	.019	26
6 inches to less than 10 inches	.024	24
10 inches to 13 inches	.030	22
14 inches to 16 inches	.036	20
Greater than 16 inches	.058	16

TABLE 23.15-B

MINIMUM VENT CONNECTOR GAUGES FOR GAS		
Diameter of Connector	Galvanized Steel Gauge Number	
	Min. thickness (inch)	Gauge
1 inch through 4 inches	.016	28
5 inches or over	.026	24

TABLE 23.15-C

**CHIMNEY CONNECTOR AND VENT CONNECTOR CLEARANCES
FROM COMBUSTIBLE MATERIALS (See Note 4)**

Description of Appliance	Minimum Clearance Inches (See Note 1)
Single-Wall Metal Pipe Connectors	
Gas Appliances Without Draft Hoods	18
Electric, Gas, and Oil Incinerators	18
Oil Appliances	18
Unlisted Gas Appliances With Draft Hoods	9
Boilers and Furnaces Equipped With Listed Gas Burners and With Draft Hoods	9
Oil Appliances Listed as Suitable for Use With Type L Venting Systems, But Only When Connected to Chimneys	9
Listed Gas Appliances With Draft Hoods (See Note 3)	6
Type L Vent Piping Connectors	
Gas Appliances Without Draft Hoods	9
Electric, Gas, and Oil Incinerators	9
Oil Appliances	9
Unlisted Gas Appliances With Draft Hoods	6
Boilers and Furnaces Equipped With Listed Gas Burners and With Draft Hoods	6
Oil Appliances Listed as Suitable for Use with Type L Vents	(See Note 2)
Listed Gas Appliances With Draft Hoods	(See Note 3)
Type B Gas Vent Piping Connectors	
Listed Gas Appliances With Draft Hoods	(See Note 3)

¹ These clearances apply except if the listing of an appliance specifies different clearance, in which case the listed clearance takes precedence.

² If listed type L venting system piping is used, the clearance may be in accordance with the venting system listing.

³ If listed type B or type L venting system piping is used, the clearance may be in accordance with the venting system listing.

⁴ The clearances from connectors to combustible materials may be reduced if the combustible material is protected in accordance with Table 23.04-B.

Comm 23.155 Multiple appliance venting.

Two or more listed gas- or liquid-fueled appliances may be connected to a common gravity-type flue provided the appliances are equipped with listed primary safety controls and listed shutoff devices and comply with the following requirements.

(1) The appliances shall be located in the same story, except for engineered venting systems.

(2) The appliances shall be joined at a manifold or Y-type fitting as close to the chimney as possible, unless the connector from each appliance enters a separate chimney inlet and the inlets are offset at least 12 inches vertically or the separate inlets occur at right angles to each other.

(3) The chimney connector and chimney flue shall be sized to accommodate the total volume of flue gases. For gas-burning appliances, the venting area shall be at least equal to the size of the largest vent connectors plus at least 50% of the area of the other vent connectors.

Comm 23.156 Condensate drains.

Provisions shall be made so that condensate from heating equipment drains into the sanitary drain system.

Subchapter VI — Fuel Supply Systems**Comm 23.16 Fuel storage.**

(1) LP GAS STORAGE TANKS. (a) All LP gas storage tanks shall be constructed, installed and maintained to conform with the applicable sections of ch. Comm 40.

(b) LP gas tanks may not be located inside dwellings.

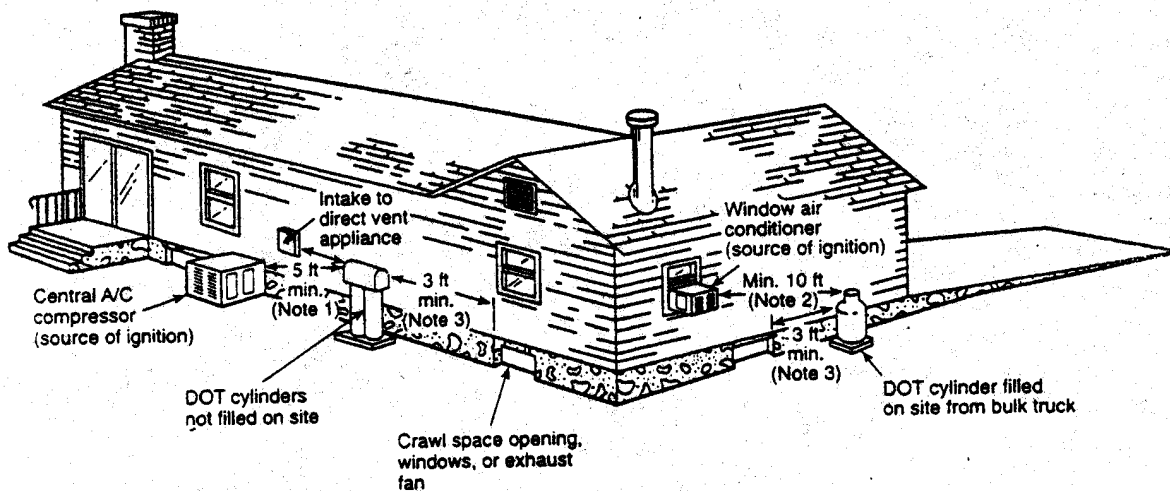
(c) LP gas tanks shall have welded steel supports and be permanently installed on concrete pads or foundations.

LP Gas Storage Tanks

Section Comm 23.16(1) states that LP gas tanks are subject to Ch. Comm 40, LP Gas Code. This code has recently been replaced with Ch. Comm 40, which adopts NFPA 58 - 1998, Standard for the Storage and Handling of Liquefied Petroleum Gases, which is summarized below. (Piping after the first stage regulator, with some exceptions, is subject to NFPA 54, National Fuel Gas Code which is adopted by s. Comm 23.16(3)). We recommend you purchase the actual codes from NFPA, the address of which is shown in s. Comm 20.24 of the UDC.

The following NFPA 58 and Comm sections summarize this section.

<u>NFPA 58</u>	<u>Comm</u>
	11.10 <i>Installer of a tank or tanks of 125 gallon or larger capacity shall notify the local fire department.</i>
[3-2.2.2]	<i>See attached excerpted table and figures for minimum distances between tanks and nearest other tank, important building or adjoining property line.</i>
	23.16(1)(a) <i>No LP tanks inside dwellings.</i>
[3-2.2.5(b)]	<i>Loose or piled combustible material and weeds not permitted within 10 feet of tank.</i>
	23.16(1)(b) <i>Tanks to have welded steel supports and to be installed on concrete pads or foundations.</i>
[3-2.2.7]	<i>No barriers around tank to trap leaked gas or to impede firefighting.</i>
[3-2.3.1 (c)]	<i>Tank protected against damage by vehicles where likely. (Four-foot tall concrete filled 6-inch steel posts are acceptable.)</i>
[3-2.3.1 (f)]	<i>Tanks to be properly painted.</i>
[3-2.5.1]	<i>First stage regulators to be as close as possible to the container and outside of buildings.</i>
[3-2.5.2]	<i>First stage regulator installed downstream of tank shutoff valve.</i>
[3-2.5.2 (b)]	<i>Regulators to be securely anchored. Regulator outlet to be faced downward to prevent entry of ice, snow or debris.</i>
[3-2.5.3]	<i>Regulator outlet to at least 3 feet horizontally away from any building opening below the level of such outlet.</i>
[3-2.6.5]	<i>Min. 5' between pressure regulator and sources of ignition.</i>



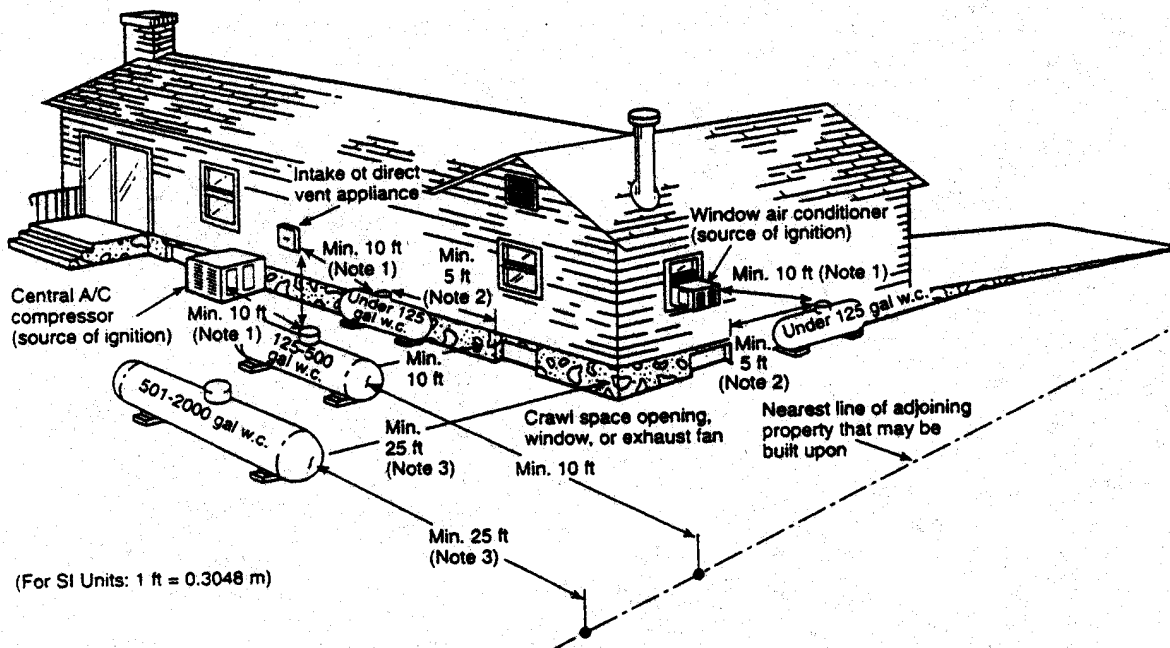
Note 1: 5-ft minimum from relief valve in any direction away from any exterior source of ignition, openings into direct vent appliances, or mechanical ventilation air intakes. Refer to Note (b) (1) under Table 3-2.2.2.

(For SI units: 1 ft = 0.3048 m)

Note 2: If the DOT cylinder is filled on site from a bulk truck, the filling connection and vent valve must be at least 10 ft from any exterior source of ignition, openings into direct-vent appliances, or mechanical ventilation air intakes. Refer to Note (b) (3) under Table 3-2.2.2.

Note 3: Refer to Note (b) (1) under Table 3-2.2.2.

Figure I-1 DOT cylinders.
(This figure for illustrative purposes only; text shall govern.)



(For SI Units: 1 ft = 0.3048 m)

Note 1: Regardless of its size, any ASME tank filled on site must be located so that the filling connection and fixed liquid level gauge are at least 10 ft from any external source of ignition (i.e., open flame, window A/C, compressor, etc.). Intake to direct vented gas appliance or intake to a mechanical ventilation system. Refer to Note (b) (3) under Table 3-2.2.2.

Note 2: Refer to Note (b) (2) under Table 3-2.2.2.

Note 3: This distance may be reduced to no less than 10 ft (3 m) for a single container of 1,200-gal (4.5-m³) water capacity or less provided such container is at least 25 ft (7.6 m) from any other LP-Gas container of more than 125-gal (0.5-m³) water capacity. Refer to Note (c) under Table 3-2.2.2.

Figure I-2 Aboveground ASME containers.
(This figure for illustrative purposes only; text shall govern.)

(2) OIL STORAGE TANKS. (a) Except as provided in pars. (b) and (c), oil storage tanks shall be installed in accordance with chs. COMM 10, Flammable and Combustible Liquids.

(b) The total storage capacity inside any dwelling unit shall be limited to 550 gallons in one tank, or not more than 275 gallons in each of two tanks cross-connected to a single burner.

(c) Oil storage tanks on the inside of any dwelling shall be located at the same level as the burner it serves.

Oil Storage Tanks

Section Comm 23.16(2) states that oil tanks are regulated by Comm 10, Flammable and Combustible Liquids Code, which covers oil equipment and is summarized below:

Petroleum Product Storage for 1 or 2 Family Dwellings

Wisconsin Administrative Code Comm 10 - Flammable and Combustible Liquids Code regulates all flammable and combustible liquids with a flash point less than 200oF and also used motor oil. This guide is intended to provide general petroleum storage tank guidance for real estate licensees dealing with 1 or 2 family residential property. The Department of Commerce has developed a free computer database accessible 24 hours a day for realtors with PC modems and Internet communication capability. The Internet database and other tank program information is accessible via the Bureau's web site, which is: <http://www.commerce.state.wi.us/ER-BSTRHomePage.html>.

Note: Local municipal ordinances may be more restrictive than the state code.

Underground Tanks

All underground storage tanks (USTs) greater than 60 gallon capacity must be registered with the Department of Commerce. The Department maintains a database that is an inventory of active, abandoned, and closed tanks. The term "closed" or "closure" refers to tanks that are properly deactivated by removal, or in special situations, authorized to be filled in place with a solid inert material. The department has published guidance brochures ERS-9881-P Permanent Closure of Underground Petroleum Storage Tanks and ERS-9880-P Temporary Closure of Underground Storage Tanks that describe the requirements for tank closure. A Commerce Internet site also provides information and guidance relating to home heating fuel tanks in Wisconsin: www.commerce.state.wi.us/ER-BSTR-ResTk.html and www.commerce.state.wi.us/ER/ER-BST-Closure.html.

Heating oil tanks installed after December 22, 1988 are required to be installed under the current Comm 10 technical requirements. Underground home heating fuel tanks of 4,000 gallons or less capacity that are currently in use must comply with the following:

a) No later than May 1, 2004 and every two years thereafter conduct a tightness test of the system (by an approved methodology) or implement an approved monthly release detection program. (Comm 10.773 (2)), or

b) No later than May 1, 2006 upgrade the system by adding corrosion protection on the tank and piping, and installing spill and overflow protection.

c) Excluded from a) and b) are underground residential heating fuel tanks that were installed before October 29, 1999 and have a capacity of less than 1,100 gallons.

May 1, 2004 becomes an important date in the life of a residential heating fuel UST that is 1,100 gallon capacity or larger. If an owner elects not to conduct the tightness test or implement the release detection program, they have until May 1, 2006 to permanently close the system, completely upgrade the system, or replace with a new system. This means that the code allows the owner to be in noncompliance with the groundwater protection provisions for five years, from May 1, 2004 to April 30, 2006.

Heating fuel tanks at other residential (multi-family units, CBRF, motels, etc.) and commercial occupancies have similar requirements. The exception being heating fuel tanks greater than 4,000 gallons capacity, which must currently have in place (Comm 10.731(1)):

Functioning monthly leak detection and by May 1, 2004 (Comm 10.771(1)):

- 1. Upgrade with corrosion protection.*
- 2. Addition of spill and overflow protection.*

Heating fuel tanks greater than 4,000 gallons capacity are not given a five-year window to be brought into compliance. Few residential heating fuel storage tanks are greater than 4,000 gallons capacity. However, the department has experienced homes with very large tanks, including one home which had a buried 10,000 gallon railroad tank car for the storage of heating fuel.

Do not assume that a buried tank with the vent and fill pipe cut off below the surface will be forgotten. Real estate licensees can lose their license for knowingly accepting Addendum A, which does not represent the presence of an underground tank.

The most frequent UST inquires are regarding "Is there a tank at a specific location?" and "Does a UST not in use have to be registered?" Use of the Commerce Internet Tank Database search will provide you with information if the tank has been registered. If there is a tank at the specific location, but it has never been registered neither the database nor Commerce staff will have any information. The tank database will also provide you with the current registration status of the tank indicating if the tank is in use, abandoned, closed, etc. USTs in use, not in use, or closed must be registered. There are no fees associated with tank registration. The Department must also be notified of a change in ownership within 10 days of ownership transfer.

Aboveground Tanks and Tanks in Basements

Aboveground tanks are tanks that are located: above ground, in vaults void of earth, or in buildings. Typically, an aboveground heating fuel storage tank at a residence is a 275 gallon oval shaped tank. Aboveground tanks at 1 or 2 family dwellings must be installed under the code's technical requirements. However, they are excluded from plan review and certified installer requirements. All aboveground heating fuel storage tanks that are connected directly to a heating device are excluded from registration.

The most frequent inquiry that we deal with relates to the heating oil storage tank located in a basement. The Comm 10 code language is written with a focus on larger aboveground storage tank located outside. However, the fire safety spirit of the code applies to all tanks. The code requires that aboveground tanks that are not in use be closed by cleaning and rendered vapor free. A tank that is not in use or has been closed for 12 months must be permanently closed. Presently, the code does not require that the closed tank be removed from the site. The closure of aboveground heating fuel tanks located at a 1 or 2 family residence does not have to be performed by an Comm 10 certified remover/cleaner (Comm 10.36 (3)(a) 2). It is important that the vent and fill pipes from a basement tank be removed from the structure when the tank is removed. If a tank is no longer in use, but is not being removed from the basement, the fill pipe must be removed and the tank inlet plugged.

Comm 10 & NFPA 31

Ch. Comm 10 adopts NFPA 31-1997, Standard for the Installation of Oil-Burning Equipment, for tank requirements, which are summarized below for inside tanks. Consult the code and standard for further details.

2-3.4	<i>Tank normally located in lowest building level</i>
2-3.6	<i>Minimum 5' between tank and any source of heat.</i>
2-3.7	<i>Tank pitched 1/4" per foot to outlet.</i>
"	<i>Shutoff required at outlet of tank.</i>
2-3.9	<i>Vent pipe.</i>
"	<i>- 2" minimum diameter.</i>
"	<i>- Terminate outside.</i>
"	<i>Fill pipe to terminate outside.</i>
2-3.10	<i>Gauging device required on tank.</i>
2-3.12	<i>Tanks provided with rigid non-combustible supports</i>
3-1.1	<i>Piping to be metallic.</i>
3-2.1	<i>Fill pipe to terminate at least 2' from any building opening at same or lower level.</i>
"	<i>Metal cover required on fill pipe.</i>
"	<i>Oil fill pipe to be identified.</i>

3-4.1	<i>Vent piping pitched to tank. Vent pipe protected from physical damage.</i>
3-4.2	<i>Vent pipe to terminate at least 2' from any building opening.</i>
"	<i>Weatherproof hood required on vent termination.</i>
"	<i>Vent to terminate above snow or ice level</i>
3-4.3	<i>Vent to terminate at least 5' from any air inlet or flue gas outlet of any appliance.</i>
3-6.3	<i>Gauge to visually or audibly tell tank filler when tank is full.</i>
3-10.1	<i>Piping to be tested.</i>

(3) GAS PIPING SYSTEMS. Gas piping systems, extending from the point of delivery to the connection with each gas-fired appliance or device, shall be installed to conform with NFPA 54, National Fuel Gas Code.

NFPA-54, National Fuel Gas Code - 1999 Edition

This National Fire Protection Association Standard (NFPA) is adopted by the code for gas piping installation only. The requirements of the National Fuel Gas Code are summarized below.

Copper Piping

Question: *Is copper piping for natural gas permitted within a dwelling?*

Answer: *Yes, if, per s. 2.6.3 of NFPA, there are no more than .3 grains of hydrogen sulfide per 100 cubic feet of gas. To this department's knowledge, all gas delivered to Wisconsin meets this limit. Installations conforming with NFPA-54 are acceptable and comply with the UDC. Municipalities or local utilities may not require the use of black iron pipe if the installation complies*

Part 1 General

1.1.1. *Code applies from point of delivery to gas utilization device for both natural and LP gases.*

["Piping" includes pipe (rigid) and tubing (flexible).]

Part 2 Design, Materials and Components

2.4.1. *Piping sized to provide an adequate supply of gas - see following tables.*

2.6.2. *Acceptable pipe - steel (black or galvanized), wrought iron, copper*, brass*, aluminum alloy (aboveground interior only).*

- 2.6.3. *Acceptable tubing - copper* (Type K or L), aluminum alloy (aboveground interior only), steel.*
- *Max. 0.3 grains of hydrogen sulfide/100 ft.³ (Wisc. okay).*
- 2.6.4. *Plastic pipe and tubing acceptable for underground exterior uses only. (Plastic LP gas piping per NFPA 58.)*
- 2.6.8. *Acceptable joints and fittings.*
- *Pipe - threaded, flanged, welded, flared (nonferrous).*
 - *Tubing - AGA approved tubing fittings, brazed (1000 DF min., no phosphorous), flared.*
- Pipe dope or tape on threaded joints unless not required by fitting manufacturer.*
- 2.7.2. *No sources of ignition (electrical equipment, flue gas exhausts, combustion air intakes, etc.) within 3 feet of gas meters.*
- 2.8.4. *Interior pressure regulators to be vented outside or vent-limited.*
- 2.8.7. *Per NFPA 58, s. 3-2.5.4, LP gas regulator to be vented so outlet is no less than 3 feet horizontally away from any building opening below the outlet.*
- 2.10 *Listed shutoff valves*

Part 3 Installation

- 3.1.2. *Underground piping to have 18" cover, 12" if not subject to hazard.*
- 3.1.5. *Underground piping to be sleeved and caulked at foundation entrance.*
- 3.1.6. *Piping underneath buildings in a conduit vented to outside and sealed at building entrance.*
- 3.2. *Aboveground exterior piping securely supported and coated or wrapped at foundation entrance.*
- 3.3.4. *Piping okay in accessible above-ceiling spaces, including plenums, but no valves allowed.*

3.3.5. *Piping not allowed in:*

- *Circulating air ducts.*
- *Clothes chute.*
- *Chimney or gas vent.*
- *Ventilating duct.*

Okay in combustion air duct.

3.3.6. *Piping support on center spacing:*

- *Pipe - 1/2" - 6'; 3/4" & 1" - 8'; 1 1/4" - 10'*
- *Tubing - 1/2" - 4'; 5/8" & 3/4" - 6'; 7/8" & 1" - 8'*

3.4.3. *Piping not allowed in solid (such as concrete) partitions.*

3.4.4 *Tubing, if not rigidly secured, can be concealed in partitions if protected against nail penetration with 16 gauge sheet metal or equivalent at penetrations of studs, plates and firestops and 4" beyond. (Note that per CSST standard, protection is for 5" beyond member.)*

3.4.3. *Piping in slab floors to be laid in channels with removable covers.*

3.4.4. *Following fittings not allowed in concealed piping:*

- *Unions.*
- *Tubing fittings including brazed fittings.*
- *Running threads.*
- *Right-and-left couplings.*
- *Bushings.*
- *Swing joints.*

3.4.5. *Reconnection into existing concealed piping:*

- *In pipe by welding, flanges, or ground joint union with center punched nut.*
- *Not allowed in tubing.*

3.8. *Outlets:*

- *Not allowed behind doors.*

- *Unthreaded portion of pipe to protrude at least 1" out of walls and ceilings and 2" above floors (quick connect devices exempt).*
- *To be capped when not used.*

3.10.1. *Gas shutoff valve required upstream of pressure regulator.*

3.10.3. *Exterior shutoff valve required at each building served.*

3.14. *Piping to be electrically continuous and bonded to any grounding electrode (may use equipment grounding conductor) but not to be used as a grounding electrode.*

Part 4 Testing

Installer shall test system at the greater of 3 psi or 1-1/2 times working pressure for at least 10 minutes prior to putting in service. If pressure drop is detected, then joints shall be tested with gas detector, soap and water or equivalent nonflammable solution

Part 5 Equipment (Connections to Piping)

5.1.16. *Equipment not to strain piping.*

5.5.1. *Equipment connectors allowed:*

- *Rigid pipe.*
- *Tubing.*
- *Listed connectors (in same room only and where not subject to damage).*
- *Listed hose connector (outdoors only).*

5.5.4. *Equipment shutoffs:*

- *Within 6' of appliance.*
- *Upstream of connector.*
- *Union downstream of valve.*

5.5.7. *Sediment trap required at all appliances except lights, ranges, dryers, gas fireplaces and outdoor grilles.*

5.5.8. *Piping not to interfere with appliance servicing (24" away from access panels).*

Sizing Gas Piping

1. Determine appliance gas demand from name plate or Table C-1.
 - Natural Gas - Use cubic feet per hour which equals BTU input divided by average BTU heating value per cubic foot of gas (typically 1000 BTU per cubic foot).
 - LP Gas - Use BTU input.
2. Measure the length of piping from point of delivery to the most remote outlet in the building.
3. Using the appropriate table, select the column showing the measured length or next longer length. This is the only column that will be used for the whole system.
4. In the selected column, find the gas demand, or next higher demand, of the most remote outlet and piping section.
5. Opposite this demand figure, find the correct gas piping size in the far left column.
6. Proceed in a similar manner for each outlet and each section of gas piping using the same column. For each piping section, determine the total gas demand supplied by that section.

Table C-1

Approximate Gas Input for Typical Appliances

Appliance	Input BTU per hour (Approximate)
Range, Free Standing, Domestic	65,000
Built-In Oven or Broiler Unit, Domestic	25,000
Built-In Top Unit, Domestic	40,000
Water Heater, Automatic Storage 30 to 40 Gallon Tank	45,000
Water Heater, Automatic Storage 50 Gallon Tank	55,000
Water Heater, Automatic Instantaneous (2 Gallons Per Minute	142,800
Capacity (4 Gallons Per Minute	285,000
(6 Gallons Per Minute	428,400
Water Heater, Domestic, Circulating or Side-Arm	35,000
Refrigerator	3,000
Clothes Dryer, Type 1 (Domestic)	35,000
Gas Light	2,500
Incinerator, Domestic	35,000

For specific appliances or appliances not shown above, the input should be determined from the manufacturer's rating.

Table C-4

Maximum Capacity of Pipe in Cubic Feet of Gas per
Hour for Gas Pressures of 0.5 Psig or Less and a
Pressure Drop of 0.5 Inch Water Column

(Based on a 0.60 Specific Gravity Gas)

Nominal Iron Pipe Size, Inches	Internal Diameter, Inches	Length of Pipe, Feet													
		10	20	30	40	50	60	70	80	90	100	125	150	175	200
1/4	.364	43	29	24	20	18	16	15	14	13	12	11	10	9	8
3/8	.493	95	65	52	45	40	36	33	31	29	27	24	22	20	19
1/2	.622	175	120	97	82	73	66	61	57	53	50	44	40	37	35
3/4	.824	360	250	200	170	151	138	125	118	110	103	93	84	77	72
1	1.049	680	465	375	320	285	260	240	220	205	195	175	160	145	135
1 1/4	1.380	1,400	950	770	660	580	530	490	460	430	400	360	325	300	280
1 1/2	1.610	2,100	1,460	1,180	990	900	810	750	690	650	620	550	500	460	430
2	2.067	3,950	2,750	2,200	1,900	1,680	1,520	1,400	1,300	1,220	1,150	1,020	950	850	800
2 1/2	2.469	6,300	4,350	3,520	3,000	2,650	2,400	2,250	2,050	1,950	1,850	1,650	1,500	1,370	1,280
3	3.068	11,000	7,700	6,250	5,300	4,750	4,300	3,900	3,700	3,450	3,250	2,950	2,650	2,450	2,280
4	4.026	23,000	15,800	12,800	10,900	9,700	8,800	8,100	7,500	7,200	6,700	6,000	5,500	5,000	4,600

Table C-6

Maximum Capacity of Semi-Rigid Tubing in Cubic Feet
of Gas per Hour for Gas Pressures of 0.5 Psig or Less
and a Pressure Drop of 0.5 Inch Water Column

(Based on a 0.60 Specific Gravity Gas)

Outside Diameter, Inch	Length of Tubing, Feet													
	10	20	30	40	50	60	70	80	90	100	125	150	175	200
3/8	27	18	15	13	11	10	9	9	8	8	7	6	6	5
1/2	56	38	31	26	23	21	19	18	17	16	14	13	12	11
5/8	113	78	62	53	47	43	39	37	34	33	29	26	24	22
3/4	197	136	109	93	83	75	69	64	60	57	50	46	42	39
7/8	280	193	155	132	117	106	98	91	85	81	71	65	60	55

Table C-16

Maximum Capacity of Pipe in Thousands of BTU per Hour
of Undiluted Liquefied Petroleum Gases (at 11 Inches
Water Column Inlet Pressure)

(Based on a Pressure Drop of 0.5 Inch Water Column)

Nominal Iron Pipe Size, Inches	Length of Pipe, Feet												
	10	20	30	40	50	60	70	80	90	100	125	150	
1/2	275	189	152	129	114	103	96	89	83	78	69	63	
3/4	567	393	315	267	237	217	196	185	173	162	146	132	
1	1,071	732	590	504	448	409	378	346	322	307	275	252	
1 1/4	2,205	1,496	1,212	1,039	913	834	771	724	677	630	567	511	
1 1/2	3,307	2,299	1,858	1,559	1,417	1,275	1,181	1,086	1,023	976	866	787	
2	6,221	4,331	3,465	2,992	2,646	2,394	2,205	2,047	1,921	1,811	1,606	1,496	

Table C-17

Maximum Capacity of Semi-Rigid Tubing in Thousands
of BTU per Hour of Undiluted Liquefied Petroleum Gases
(at 11 Inches Water Column Inlet Pressure)

(Based on a Pressure Drop of 0.5 Inch Water Column)

Outside Diameter, Inch	Length of Tubing, Feet									
	10	20	30	40	50	60	70	80	90	100
3/8	39	26	21	19	--	--	--	--	--	--
1/2	92	62	50	41	37	35	31	29	27	26
5/8	199	131	107	90	79	72	67	62	59	55
3/4	329	216	181	145	131	121	112	104	95	90
7/8	501	346	277	233	198	187	164	155	146	138

Shutoff Valves

Question: *Can a water-type valve be used as a manual gas shutoff valve?*

Answer: *No. Gas shutoff valves must be approved by AGA or UL for such use. Their approval will be indicated on the valve.*

Question: *Is a manual shutoff device acceptable on a gas fireplace starter?*

Answer: *Yes. (Gas log systems shall be installed per their listing.)*

Equipment Location

Section Comm 23.17(2) requires indoor equipment to be installed with a minimum of 24 inches clearance for service. This service clearance is only required on the face(s) of the equipment with service panels. Otherwise, lesser clearances as allowed by the listing are acceptable.

(4) SHUTOFF AND CONTROL DEVICES. (a) Any oil-fired appliance or device connected to a fuel piping system shall have an accessible, approved manual shutoff valve installed upstream of any connector.

(b) Automatic gas-burning heating appliances shall be equipped with listed devices which will shut off the gas to the pilot light and main burner(s) in the event of pilot failure.

(c) Liquid fuel-burning appliances shall be equipped with primary safety controls which will shut off the flow of fuel to the burner(s) in the event of ignition failure.

Subchapter VII — Equipment Location and Operation

Comm 23.17 Equipment location.

(1) OUTDOOR EQUIPMENT. Outdoor equipment shall be located so as to not restrict the air flow or recirculation of air. Outdoor equipment so located as to be subject to damage shall be protected.

(2) INDOOR EQUIPMENT. All indoor equipment shall be installed with a minimum of 24 inches of clearance for service.

Comm 23.18 Operation.

(1) INSTRUCTIONS. Written instructions shall be provided the owner for the operation and maintenance of the system and equipment.

(2) FINAL TEST REQUIRED. The installer shall test and balance every heating, ventilating and air conditioning system.

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Summary of Rules for Water Heaters Used for Space Heating
2/04/2004

Note: The Uniform Dwelling Code (UDC), Chs. Comm 20-25, applies to only one- and two-family dwellings built since 1980. The WI Commercial Building Code, Chs. Comm 61-65 and the WI-amended 2000 IMC, IECC and IFGC apply only to commercial and multi-family dwellings. The WI Plumbing Code, Chs Comm 82-87, apply to all buildings. Note the code from which a requirement arises and to what buildings it therefore applies.

- **WI Boiler Code:** Section Comm 41.45(1) of this code excepts water heaters from the boiler code.
- **Listing:** Per ss. Comm 23.04 and IFGC 629, water heaters used for space heating need to be listed for such use. The data plate shall indicate that the unit can be used for simultaneous space heating. Section IFGC 623 specifies that they be listed per ANSI Z21.10.1 or ANSI Z21.10.3. This standard is intended for dual use, which means that in addition to the heating use, it shall also be used for potable use, which may be satisfied with at least one properly connected water fixture. (A hose bibb is a fixture.)
- **Unlisted Space-Heating Only Equipment** - Water heaters listed per ANSI Z21.10.1 or ANSI Z21.10.3 that are used for space-heating only would be considered unlisted. Section IFGC 65.0301 for gas-fired appliances and s. Comm 64.0301(2) for other fuels allow unlisted equipment if a Wisconsin-registered engineer or architect tests the appliance output and safety controls to these or other appropriate standards as determined by the manufacturer. This may be done for each installation or the manufacturer may obtain a WI Material Approval for repetitive installations. These Material Approvals may also be valid under the UDC.
- **Efficiency:** Federal appliance efficiency standards have usurped our efficiency requirements for smaller appliances for which they have developed a standard. They require that a manufacturer meet the standard applicable for the type of appliance that they market an appliance as. There is a federal standard for potable water heaters. There is a federal standard for boilers, which would apply to water heaters used for space heating only. There is **no** state or local responsibility or authority to enforce the federal rules.
- **Sizing:** Per s. Comm 22.12(2), the water heater shall be oversized for potable water usage between 43% and 49% of the calculated space heating usage. Per s. Comm 64.1001, s. IFGC 623 for gas appliances and s. Comm 82.40(5)(a), a dual-use water heater shall be sized to provide sufficient hot water to supply both the daily and hourly peak loads of the building.
- **Plumbing Code:** Any equipment or piping that comes in contact with potable water must meet the potable water plumbing materials standards. (A WI Plumbing Products Approval is not required anymore.) The installation of the system that comes in contact with the potable water system must be installed by a properly credentialed plumber. A floor drain must be provided for the water heater, if the water heater is installed on the lowest floor level. If a heat exchanger is used and only food grade additives are used, it may be a single-wall heat exchanger. If non-food grade additives are used, then the heat exchanger shall be a vented, double wall heat exchanger as required by s. Comm 82.41(3)(d). The valving and safety devices on the system must comply with the Plumbing Code.
- **Non-potable piping:** If the listing, engineer/architect statement or WI Material Approval permits the installation of backflow prevention at the water heater inlet or isolation of the water heater, then non-potable material potable water materials may be used. Nonpotable, heat distribution piping standards are not specified in either code.
- **Backflow Protection:** If backflow protection is installed before the water heater, then the buildings water system is no longer available for expansion of the heated water. The temperature-pressure relief valve must be selected in coordination with the backflow preventer. There needs to be an

expansion tank or other expansion means provided. These items, if allowed, shall be installed per the water heater's listing.

- **Temperature Setting** – Per s. 704.06 of the State statutes, a residential landlord shall set the potable water heater temperature no higher than 125 degrees F. Per s. Comm 81.01(126) of the Plumbing Code, the minimum water temperature for hot potable water is 110 degrees F.
- **Isolated Water Heaters:** If a water heater is installed with no connection to the potable water system, then typically proper water expansion means shall be provided per the water heater's listing.
- **Pipe Insulation** - Per ss. Comm 22.19 and 63.1029, heating pipes shall be insulated to R-4 when passing through unheated spaces.
- **Combustion Air** – Combustion air shall be provided per ss. Comm 23.08, IMC 701 or IFGC 304.

For further questions, contact your local building inspector or the State Division of Safety and Buildings at (608)266-3151.

Optional Uniform Dwelling Code (UDC) Makeup and Combustion Air Worksheet (3/12/01)

Project Address _____ **Completed by:** _____ **Tel.** _____

Background: The UDC applies to all one and two family dwellings built since June 1, 1980. Section Comm 23.02 of the UDC requires that outside **makeup air** be supplied to balance mechanical exhaust ventilation, including required bathroom fans, so that adequate air change occurs, without backdrafting of open combustion heating appliances. Section Comm 23.06 of the UDC requires that adequate **combustion air** be supplied to heating appliances for complete fuel combustion and flue gas venting purposes, which should minimize carbon monoxide hazards. This worksheet demonstrates compliance with both requirements.

If your dwelling does not have any open combustion appliances, then you do not have any **combustion air** requirements and, by code, can rely upon infiltration through building cracks for **makeup air ONLY** if you calculate cracks as allowed by the code. See Comm 22.30 and commentary language for calculations. Open combustion appliances are those which use air from within the dwelling for combustion.

NOTES: Typical appliance values are given in the tables, however use actual values if known. **Round pipe** has the following areas: 3" dia. pipe - 7 sq in, 4" - 12 sq in, 5" - 20 sq in, 6" - 28 sq in, 8" - 50 sq in, 10" - 79 sq in, 12" - 113 sq in. **Opening Restrictions:** If louvers or screening is provided on an opening, then multiply its gross area by the following factors to obtain the net area (alternatively, knowing the net area, divide to obtain the gross area): 1.0 for 1/4" hardware cloth, 0.8 for 1/8" screen, 0.75 for metal louvers, 0.5 for metal louvers and 1/8" screen, and 0.25 for wood louvers.

A. Makeup Air - Complete the following table for exhaust fans, but not recirculating, whole house fans, attic fans or inlets of balanced ventilation systems.

Intermittent Exhaust Fans	Typical Exhaust CFM	OR Actual CFM	Number	Total (cfm)
Bathroom fan (min. 50 cfm)	75		x	
Resid. kitchen range hood	180		x	
Downdraft range exhaust	400		x	
Electric clothes dryer	175		x	
Gas clothes dryer	150		x	
SubTotal				
Intermittency Adjustment Factor				X .40
Adjusted Total				
Any constant exhaust fans without dedicated makeup air				+
Net Grand Total Makeup Air Required				

You can provide makeup air via the following methods (check appropriate boxes). Note that openings or ducts shall be provided between the source of the makeup air and the exhaust fans.

- ☐ **Intake fans with a capacity equal to the Grand Total above.** If ducts are connected to the fan, the fan capacity shall be appropriately adjusted.
- ☐ **Openings to the outside, ducted to the return plenum of the furnace** to provide tempering and distribution. Multiply the Grand Total by the appropriate restriction factor for louvers or screening to obtain the gross makeup air required:

_____ (Net Grand Total Makeup Air Required) ÷ _____ (Opg Restr. Factor) = _____ (Adjusted Makeup Air Req'd)
 The calculated capacity for round intake duct is: 3" - 38 cfm; 4" - 69 cfm; 6" - 157 cfm; 8" - 279 cfm (Circle planned size)

Section Comm 22.14 requires outside makeup air openings to have manual shutoff means and automatic or gravity dampering means for periods when no makeup air is required. Because of this dampering requirement, you may **not** use makeup air openings for combustion air openings, which are prohibited to have dampers.

B. Combustion Air (Note that appliance manufacturer requirements may be more restrictive.)

There are several methods of providing combustion air, of which you will choose one for each group of appliances in a common space. First, complete the table **for open combustion appliances** on the next page to determine if you can comply with method 1 or 2, below, which allows at least some inside combustion air. Otherwise, choose another method from the next page.

1. Inside Air (Discontinuous Vapor Retarder): Allows combustion air to be drawn from an inside space if the building has a discontinuous vapor barrier, as is permitted at box sills by s. 22.22. The space shall provide a room volume of at least 50 cubic feet per 1000 btu/hr combined input rating of all open combustion appliances in that space. **Room Interconnection:** An inside space may include several rooms if connected with **high and low openings**, with each opening providing one square inch of clear opening per 1,000 btu/hr input rating, but not less than 100 square inches each. Remember to apply the above Opening Restriction Factors for louvers on the openings.

Room Interconnection: Net Sq. In. Req'd at Input/1,000: _____ (Min. 100 sq.in.) ÷ _____ (Opg. Restr. Factor) = _____ sq.in. **each opg;**

Appliance	Appl. Group Number	Typical BTU/hr Input	Actual BTU/hr Input	Total BTU/hr in Each Numbered Group of Appliances That Share a Space	Room or Interconnected (per Method 1) Space Volume	Room Volume Divided by [Total BTU/hr in Room ÷ 1,000]*
Furnace <input type="checkbox"/> Gas <input type="checkbox"/> Other		100,000		Appl. Group 1		
Gas or Oil Water heater		50,000		Appl. Group 2		
Gas clothes dryer		35,000				
Gas fireplace		50,000		Appl. Group 3		
Gas range		65,000				
Wood stove or fireplace (Input per Cu. Ft of firebox capacity)		100,000				

***If any room, or interconnected group of rooms, provide less than 50 cu ft per 1,000 BTU/hr of all appliances within, per the last column of the table, or the dwelling has a continuous vapor barrier, then choose one of the appropriate methods below. Enter the appliance group number in front of the applicable method. You can skip to Method 4 or 5 if the room is small and isolated.**

2. Inside & Outdoor Air (Continuous Vapor Retarder): If dwelling has a continuous vapor barrier, and therefore cannot use method 1 of taking all air from inside, but per the above table has a room volume of at least 50 cubic feet per 1000 BTU/hr combined appliance input rating, then provide supplemental outside air via a single, direct or ducted, exterior, high opening, sized at one square inch per 5,000 btu/hr combined input rating.

Appl
Group#

Exterior Opening:

Net Sq. Inches Required at Input/5,000: _____ ÷ _____ (Opg. Restr. Factor) = _____ sq. in.; Planned Opg. Dim.: _____

Room Interconnection:

Net Sq. In Req'd at Input/1,000: _____ (Min. 100 sq. in.) ÷ _____ (Opg. Restr. Factor) = _____ sq. in. **each opg;**

3. Single Outdoor Opening (Gas Appliances Only): If serving only gas appliances, then provide outdoor air via a single, direct or ducted, exterior, high opening sized at one square inch per 3,000 BTU/hr combined input rating, but not smaller than the combined cross sectional areas of the appliance flue outlets in that space.

Appl
Group#

a. Sizes & areas of flues: _____ Total flue area: _____ sq in.

b. Net Sq. In. Required at Input/3,000: _____ sq in..

Greater of a. or b.: _____ ÷ _____ (Opg. Restr. Factor) = _____ sq. in.; Planned Opg. Dim.: _____

4. Prorated Inside Air Credit Plus Outdoor Air: Calculate the pro-rated credit for an inside space that partially meets method 1, and then make up the difference by pro-rating the outside combustion air otherwise required by method 5. **Example:** If the inside space provides only 25 cubic feet per 1,000 BTU/hr (**per last column of table above**), or half of the size required by method 1, then the additional direct or ducted outside combustion air, as calculated by method 5 can be reduced by one half.

Appl
Group#

Pro-rating credit: **100%** - [_____ (Actual room vol. per 1000 BTU/hr) x 2] = _____

5. Two Outdoor Openings: Provide outdoor air via high and low, direct or vertically ducted, exterior openings, each sized at one square inch per 4,000 BTU/hr combined input rating; or via horizontally ducted openings, each sized at one square inch per 2,000 BTU/hr combined input rating.

Appl
Group#

☐ Direct or Vertical Ducts: Sq In Required at Input/4,000: _____ sq in x _____ (Credit from 4.) = _____ sq in.

☐ Horizontal Ducts: Sq In Required at Input/2,000: _____ sq in x _____ (Credit from 4.) = _____ sq in.

Net Sq. Inches Required: _____ ÷ _____ (Opg. Restr. Factor) = _____ sq. in.; Planned Opg. Dim.: _____